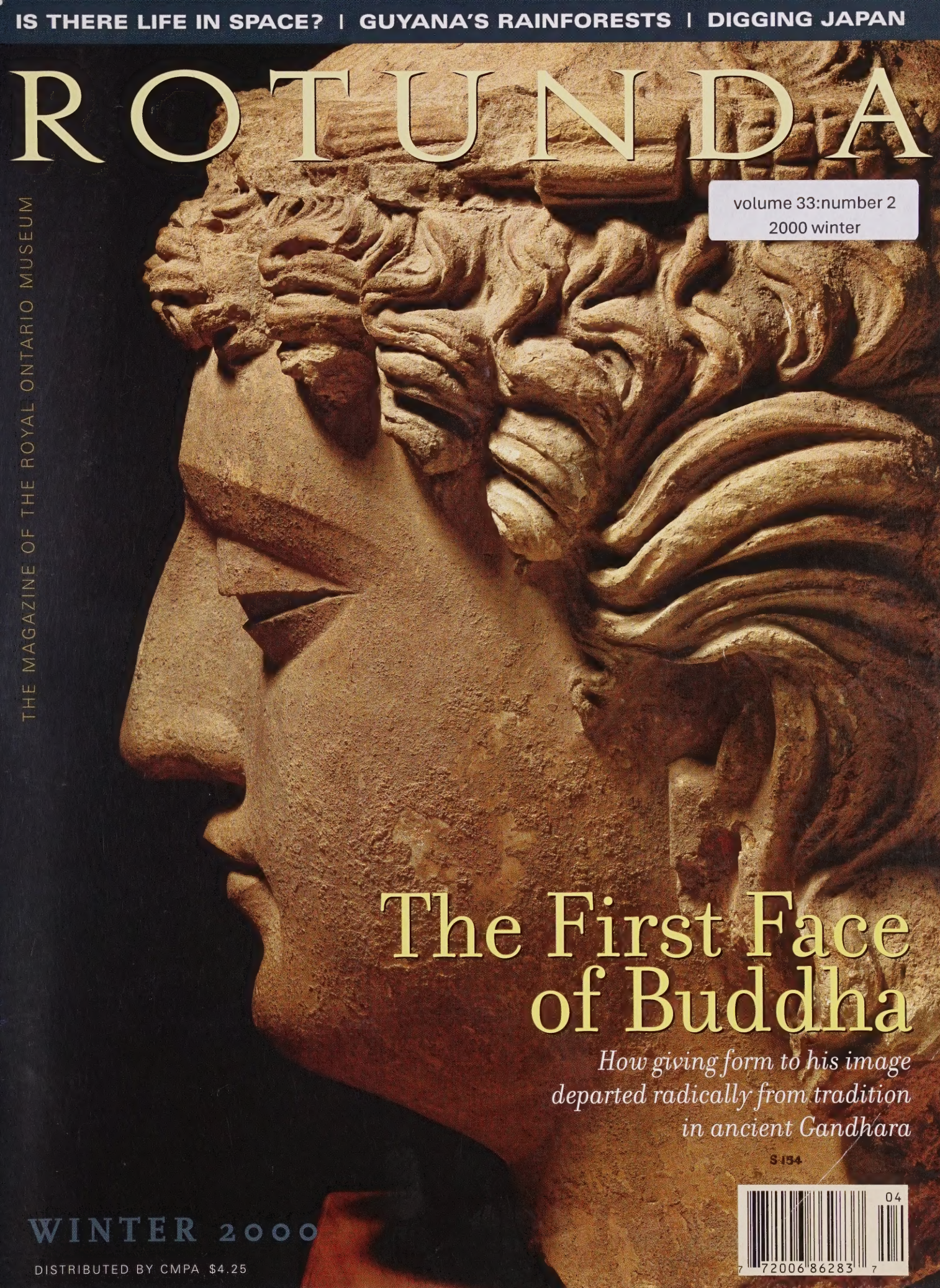
IS THERE LIFE IN SPACE? | GUYANA'S RAINFORESTS | DIGGING JAPAN

ROTUNDA

THE MAGAZINE OF THE ROYAL ONTARIO MUSEUM

volume 33:number 2
2000 winter



The First Face of Buddha

How giving form to his image departed radically from tradition in ancient Gandhara

S-134

WINTER 2000

DISTRIBUTED BY CMPA $4.25

04

7 72006 86283 7

David Milne, R.C.A. **Hotel and Butcher Shop, 1931** **18 x 22 inches**

Masters Gallery ltd.

815 C 17th Ave., S.W., Calgary AB. T2T 0A1
(403) 245-2064 • (403) 245-2065

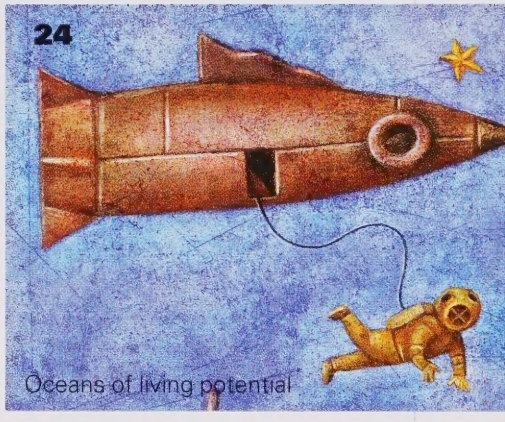
mastersgalleryltd.com

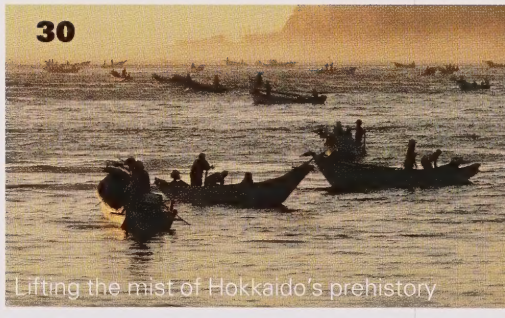
CONTENTS

Volume 33, Number 2, Winter 2000

FEATURES

DEPARTMENTS

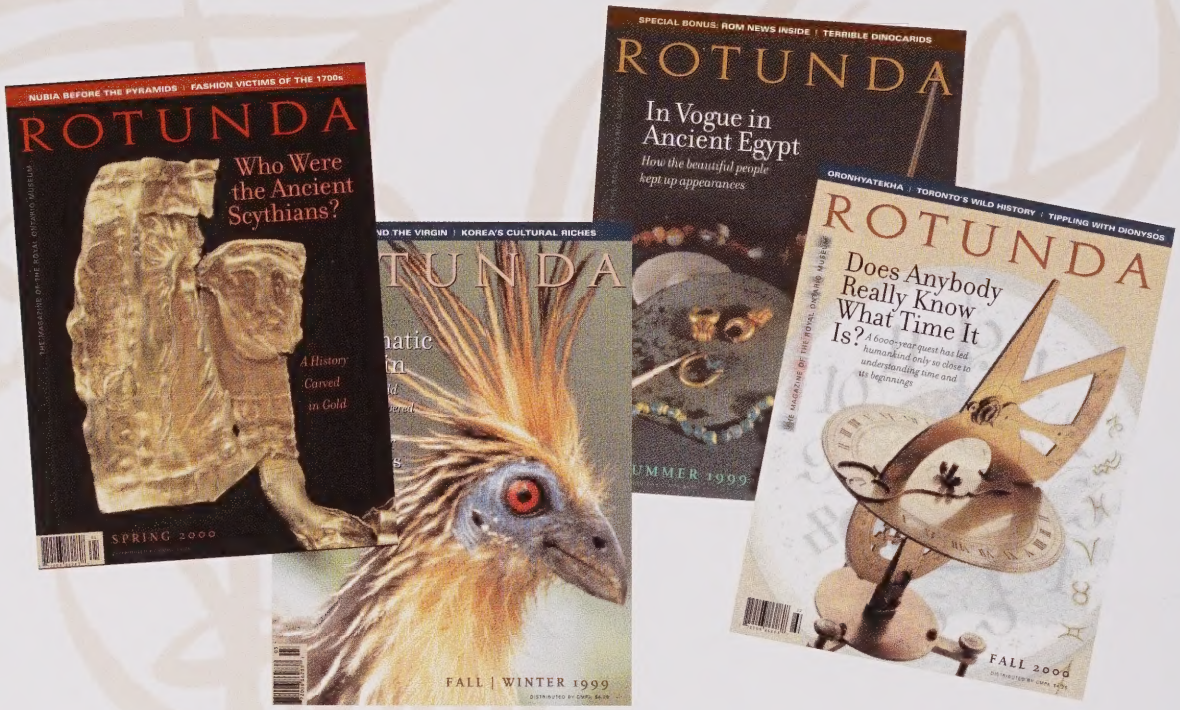




COVER IMAGE: BRIAN BOYLE, ROM

ROTUNDA

GIVE A GIFT OF WONDER



SEND ROTUNDA TO A FRIEND

Give a year of Rotunda *and you're giving a gift of excitement and exploration, perfect for that friend with a passion for collecting, a curious cousin, or that hard-to-buy-for history buff in your life.*

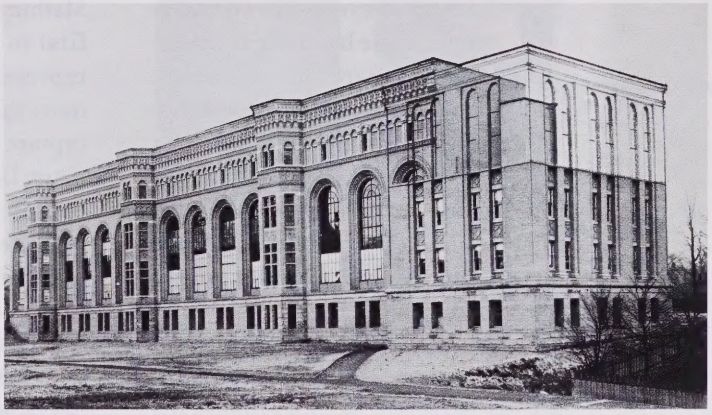
With everything from ancient civilizations to scientific breakthroughs, Rotunda *brings to life a world of discovery. Our writers will take your friends and family with them as they solve ancient mysteries, look in depth at the wonders of nature, tackle the tough questions of conservation and ecology, and examine the arts of humankind throughout the ages.*

For just $12 (plus GST) you can give three colourful, illuminating issues. It's a gift that keeps giving all year long. Wrap up your shopping for the season by subscribing now. The first issue will arrive in February 2001.

THE MAGAZINE OF THE ROYAL ONTARIO MUSEUM

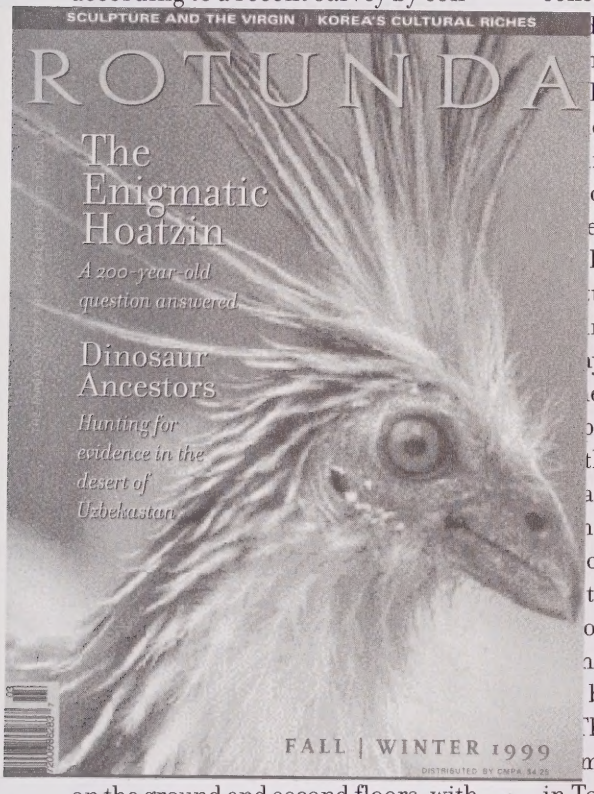
WILLIAM THORSELL

MANY MAJOR buildings have been renovated over the years to accommodate new uses and architectural fashions. Some buildings have been improved as a result, some have been destroyed, and some have been wounded. The great historic buildings of the Royal Ontario Museum fall into the last category—wonderful structures, several of whose finest attributes have been covered over and lost to public use.



The ROM in 1914, shown from the southwest with a proposed addition drawn on.

The buildings are well cared for and in fundamentally good condition according to a recent survey by con-



on the ground and second floors, with a larger expanse on the north face. Both of the original, historic ROM buildings gave high priority to elegant windows as a source of natural light.

Most of these were covered over years ago, and new interior walls were installed against them to house various galleries and features. Sometimes the motivation was protection of light-sensitive artifacts from damage. But dominant reason was the fashion he times, where self-contained lay environments were preferred ore publicly linked spaces. Con- ing the whole experience meant osing it, thus obscuring windows ed to the outside world.

he second trend that deprived us tractive architectural values was nstallation of dropped ceilings in y older buildings. This was seen e Art Gallery of Ontario when the pped ceilings in rooms surround- the Walker Court were removed a ade ago, revealing wonderfully rooms with coffered ceilings in original style. Another example ts in the Summerhill liquor store oronto, where the soaring ceilings ne original train station are hid- behind low ceiling panels.

The ROM has many more such ms than any other historic building in Toronto. The great galleries in the Museum's two older spines have been reduced in volume and stature with the lowering of many ceilings and the erection of dividers and walls. Large, high, sunny galleries originally running the lengths of these buildings are now broken into subdued and smaller spaces that deny the uniqueness of their patrimony.

The third influence undermining our original spaces is the purpose to which some of them are given. Commercial uses command prime gallery spaces, temporary galleries stay dark for extended periods in some of our finest rooms, secondary missions command uniquely attractive spaces—the lovely, high, windowed vault hidden from view behind the dinosaur gallery on the north end of the east wing, for example. Again, the marvellous attributes of the ROM's historic architecture are lost.

Happily, all these things can be reversed in the context of an ambitious and intelligent Master Plan. The great luminous halls of the original ROM can be retrieved and returned to highest use to display and explain our finest and most important collections—including our Canadian collections. At the same time, some current spaces inside the building that are poorly conceived will be re-engineered and applied to much more productive purposes.

Great museums have always understood great architecture to be an integral part of their character, and part of a coherent visitor experience. The architecture need not be intimidating or overly sober—consider the Guggenheim in New York and in Bilbao, Spain. But the architecture should be wonderful and wonderfully used in the service of the museum's content.

Among the ROM's many hidden treasures is the architecture of its original buildings. If we are able to raise resources adequate to fund our ambitious Master Plan, the grace and grandeur of the original ROM will return alongside some new and excellent construction, all in the service of fine collections intelligently and creatively displayed.

ROTUNDA

EXECUTIVE EDITOR
Sandra Piller
EDITOR
Lee-Anne Jack
DESIGN AND PRODUCTION
Peter Enneson Design Inc.
PHOTOGRAPHY
Brian Boyle
CONSULTING EDITOR
Anna Kohn
CONTRIBUTING EDITORS
Cathy Ayley
Mary Burridge
Glen Ellis
Mark Engstrom
Peter Kaellgren
Julia Matthews
Susan Stock

ADVERTISING SALES
Sandra Piller, Executive Editor
(416) 586-5758

EDITORIAL AND MARKETING OFFICES
Rotunda, the magazine of the Royal Ontario Museum, 100 Queen's Park, Toronto, Ontario M5S 2C6, or telephone (416) 586-5585, e-mail lee-anne@rom.on.ca
ROM Web site: www.rom.on.ca

Published three times per year by the Royal Ontario Museum © The Royal Ontario Museum, 2000. Printed and bound in Canada. Indexed in the Canadian Periodical Index and the Canadian Magazine Index and available on-line in the Canadian Business & Current Affairs Database ISSN 0035-8495. Canadian Publications Agreement # 1460072

SUBSCRIPTIONS & SINGLE COPY SALES
Subscriptions $11.97 (3 issues) plus 7% GST, outside Canada add $6 for postage and handling; single copies $4.25 plus 7% GST. All circulation and subscription inquiries should be addressed to *Rotunda*, Royal Ontario Museum, 100 Queen's Park, Toronto, Ontario M5S 2C6. Phone: (416) 586-5758, Fax: (416) 586-5649

THE ROM GRATEFULLY ACKNOWLEDGES THE LOUISE HAWLEY STONE CHARITABLE TRUST FOR ITS GENEROUS SUPPORT OF THIS PUBLICATION

LEE-ANNE JACK

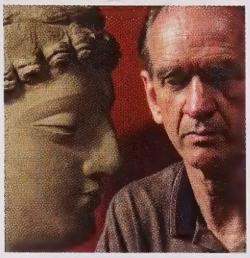
LOOKING BEYOND the immediately visible has brought scientists to startling revelations about our world and its inner workings over thousands of years of experiment and exploration. Throughout much of this history, researchers have directed their attention skyward, attempting to determine whether there is more up there than meets the eye—whether there could be life in space. In one of our feature stories, ROM research associate Francesco Santini explores the abundant new findings that relate to this question—the science of bioastronomy. Surprisingly, our own oceans have revealed secrets that may well have upped the odds of finding life beyond Earth.

Just as scientists have looked beyond the tangible for answers, so artists have reached to other realms for inspiration. The talented sculptors of ancient Gandhara, a square of land in what is today northern Pakistan, took a leap of faith during the 1st century BC when they, along with the Mathura culture in India, became the first to put a human face on artistic representations of the Buddha. But more than this, their works attempt to capture the very essence of enlightenment. David Jongeward, an independent researcher and writer with a special interest in ancient Central Asian civilizations, travelled to Pakistan to explore the ruins of this venerable school of art. In this issue he takes you with him on a journey to one of the best known of Gandhara's now-ruined, partly excavated monasteries, Takht-i-Bahi.

In dig sites across the ocean in northern Japan, ROM research associate Gary W. Crawford has been researching the prehistory of Hokkaido for more than 25 years. A palaeoethnobotanist—he studies plants and people in the past—Gary was astonished by the parallels he uncovered in the prehistoric paths of the people of Hokkaido and those of southeastern Ontario. For *Rotunda*, he sets out his surprising findings to date. He continues to search for the pertinent questions that will lead us toward answers about the emergence of northern agricultural societies in both hemispheres.

In the rainforests of Guyana, one of the most biodiverse nations of Central America, ROM biologists Burton Lim and Mark Engstrom have for the last decade been carefully mapping the country's mammal populations. Their work, in conjunction with other organizations around the world, is critical to determining conservation priorities and provides a key benchmark against which the impact of future development can be measured. In this issue, Burton and Mark detail their efforts and tell of the colourful characters they've met along the road.

Wherever your own roads take you this season I wish all of you the very best for the holidays and for a happy 21st century as it begins.



David Jongeward

Freelance Writer

David Jongeward (*Imagining Buddha*), an independent researcher and writer, was introduced to the arts of ancient Central Asian civilizations at the British Museum 15 years ago, and has done research in India and Pakistan. In a past life, he was a cultural anthropologist and instructor, specializing in comparative religions. He recently returned to academe this time as a student via a degree program with the Centre for South Asian Studies at the University of Toronto.

Gary W. Crawford

Anthropology Department

Dr. Crawford (*43rd Parallels*) is an archaeologist, the associate dean of Social Sciences at the University of Toronto at Mississauga, and a research associate in the ROM's Anthropology Department. His research focuses on the relationships between people and the environment, particularly plants, in prehistory. He has projects ongoing in China as well as in Ontario and Japan. He considers Hokkaido to be his second home.

Burton Lim

Centre for Biodiversity and Conservation Biology

Burton Lim (*On the Road to Conservation*) is assistant curator of mammals at the ROM. He has collaborated with Dr. Engstrom (above right) since 1990 on the biodiversity and conservation of mammals in Guyana. His primary area of research is the systematics and biogeography of neotropical bats.

Mark Engstrom

Centre for Biodiversity and Conservation Biology

Dr. Engstrom (*On the Road to Conservation*) is director of research at the ROM and a senior curator of mammalogy. His research focuses on the evolutionary biology and systematics of mammals, especially rodents and bats. Fieldwork has taken him to places as diverse as the high Arctic tundra and the heart of the Amazon rainforest.

Francesco Santini

Centre for Biodiversity and Conservation Biology

Francesco Santini (*The Heavens and the Deep Blue Sea*) is a graduate student in the Department of Zoology, University of Toronto, and in the ROM's Centre for Biodiversity and Conservation Biology. Born in Italy, he is now in the process of finishing his Ph.D. in zoology, specializing in the evolution of deep-sea fishes. He continues to look for biospheres in outer space.

BRIAN BOYLE , ROM / M 47892

Precious Fire

Tanzanite dazzles in Tiffany brooch

Introduced to the world in 1968 by Tiffany & Co., tanzanite is one of the world's most beautiful gems. Named for Tanzania, its country of origin, tanzanite is the blue-violet variety of the mineral zoisite. It is magnificently featured in the spectacular "Fireworks" brooch, pictured above, which was recently donated to the ROM by Tiffany & Co. The 12-carat tanzanite is set in platinum and 18-karat yellow gold and is surrounded by shooting rays of 132 round, mixed-cut tanzanites weighing a total of 13 carats, and 78 round brilliant-cut diamonds weighing 4.43 carats. Dramatic pyrotechnic displays bursting into the night sky inspired its design. The brooch is on display in the ROM's S. R. Perren Gem and Gold Room in the Dynamic Earth: Inco Limited Gallery of Earth Sciences.

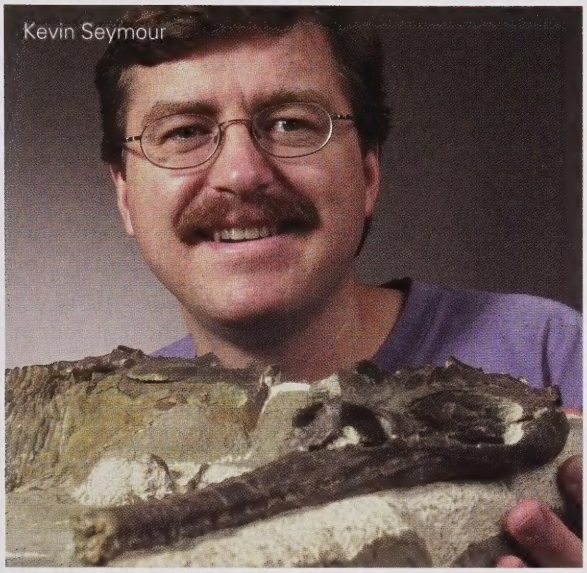
BRIAN BOYLE, ROM / 961.232.25 A-N

Tudor Tablewares

Dessert trenchers the best thing since sliced bread

Wooden household articles called "treen" were common in Tudor times, but nearly all were lost over the centuries because of their perishability and relatively low intrinsic value. In 1961, the ROM obtained a rare set of 12 English dessert trenchers, pictured above, when Louise Hawley Stone purchased them for the Museum from a prominent dealer in New York City. They date to around 1600, late in the reign of Elizabeth I. The word "trencher" is of French derivation. During the Middle Ages, food was often served on a slice of bread—the French verb "to slice" is *trancher*. As time went on, a piece of turned or finished wood was used in place of the bread. During the 1600s, English sailors were served on square trenchers with a low rim around the edge: inexpensive, durable, and easy to store on board ship. Even though most of these humble trenchers decayed long ago, their memory lingers on in the expression "a square meal." In the Tudor period, formal meals were elaborate events with many courses, musicians, and entertainments. This set of small round trenchers would have been used on festive occasions in an educated household, where the guests could read. Each trencher, painted in colours and ink, has a rhyming couplet in the centre, from an unknown source, surrounded by verses from Coverdale's translation of the Bible. A trencher would have been placed in front of each guest to hold raisins, almonds, fruit, nuts, or confections. After the sweets were consumed, each guest would have recited the poem or saying printed on the trencher. It all sounds a bit like the jokes you find in traditional English Christmas crackers.

Peter Kaellgren



BRIAN BOYLE, ROM / ROM 50,000

Champsosaur Champ

Predatory reptile superbly preserved

At the annual mineral and fossil show in Tucson, Arizona, last February, ROM palaeontologists Desmond Collins, Kevin Seymour, and David Rudkin spotted an almost complete skeleton of a *Champsosaurus* for sale. Through a generous grant from the Louise Hawley Stone Strategic Acquisitions Fund, the specimen was recently purchased. Scattered remains of this type of predatory reptile, superficially a crocodile look-alike, are not uncommon in the Upper Cretaceous deposits of western North America, from a time when dinosaurs flourished. Unlike the dinosaurs that became extinct at the end of the Cretaceous, however, champsosaurs survived for another 30 million years. Articulated specimens such as this superb fossil are extremely rare. The front and hind feet, including the wrists and ankles, and the ventral ribs (called gastralia), are all well preserved. Normally these fragile parts are either poorly preserved or absent. The Museum has a venerable history of studying champsosaurs. William Arthur Parks, director of the Royal Ontario Museum of Palaeontology from 1913 to 1936, described several species of *Champsosaurus* based on the ROM's collections. This beautiful specimen may well provide new data to aid in understanding the still-obscure relationships of champsosaurs to other reptiles.

Kevin Seymour

COURTESY NATIONAL GALLERY OF CANADA, OTTAWA

Much-Painted Meroite

Biblical eunuch popular with 17th-century artists

Long before the archaeological remains of ancient Nubia were discovered in the 1900s, images of Meroites (Nubians) found their way into European consciousness through paintings like the one that inspired this work by Joseph Légaré. The Arab conquest of Egypt in 642 severed contact between Nubia and Europe, and images of Nubians in medieval European art are therefore rare. But in the early 17th century, with the spread of the Dutch trading empire to Africa, painters took a special interest in depicting the baptism of the eunuch by St. Philip as described in the New Testament (Acts 8: 26–40). Although texts didn't explicitly say so, it was assumed that the eunuch, who was in the service of the Ethiopian (Meroitic) queen, was black . Several examples of this scene exist, including one by Rembrandt. Légaré's painting *St. Philip Baptizing the Eunuch of Queen Candace,* above, was inspired by one of these 17th-century works. In 1803, l'abbé Philippe-Jean-Louis Desjardins acquired paintings that had been removed from Parisian churches during the French Revolution—including one of St. Philip baptizing the eunuch. The painting, variously attributed to Nicolas Poussin and Michel-Ange Challes and now simply dated to the 17th century, was purchased for the church in St.-Henri-de-Lauzon in Quebec, where Légaré made two copies of it in 1821. It is likely that this motif was appealing to the early French-Canadians for the same reasons it appealed to the 17th-century Dutch: it showed the conversion of a Native population to Christianity.

Krzysztof Grzymski

WRITE TO: *ROTUNDA*, 100 QUEEN'S PARK, TORONTO, ONTARIO, M5S 2C6.
THE EDITORS RESERVE THE RIGHT TO EDIT FOR LENGTH AND CLARITY

Flask Coincidence

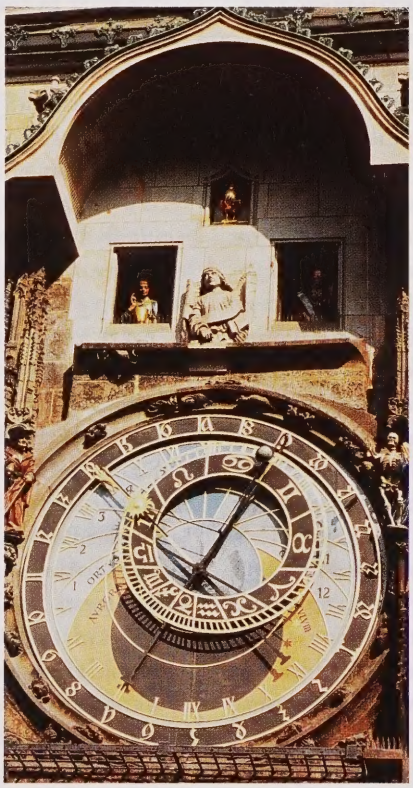
On opening the Spring 2000 issue of *Rotunda* and turning to the "ROM Answers" page, I was pleasantly surprised to see a picture of the flask I inherited from my father, (1885–1951). Well, not quite: the cup of J. L.'s flask is sterling silver; mine is only EPNS. What is more of a coincidence is that J. L. purchased the flask from a lady who had acquired it from her father-in-law, Dr. Jim Melvin. My father was Robert Melvin. However, he is unrelated.

David Melvin
Toronto, Ontario

More About Time

In your recent issue (Fall 2000) in the article "The Puzzle of Time" you mention the astronomical clock in Prague, Czech Republic. During a recent trip to Prague I photographed the Old Town Hall's astronomical clock (*staromestska radnice s orlojem*) and thought *Rotunda* readers might be interested in the photos and the clock's history. Prague's Old Town Hall was built in 1338, and the monumental clock or *orloj* has been operating since 1490. It tracks the movement of the sun compared to the moon, and indicates the twelve signs of the Zodiac. The clock tells time in three different formats: Central European Time, Old Czech Time, and Babylonian Time. In addition, every hour during the day and early evening the trap door opens and presents the medieval moralistic tale of greed, vanity, and death. It is said that the clockmaster who designed the clock, Hanus, was blinded by Prague's townsfolk to prevent him from repeating his masterpiece elsewhere. The bottom section of the clock contains a calendar added in 1865 by painter Josef Manes. The calendar depicts saint days and astronomical signs as well as the months of the year.

Mark Buck
Toronto, Ontario



LIFE ON EARTH

Maples — Think Canadian

As foreign maple species escape cultivation and invade natural habitats, they may be putting Canada's most cherished symbol at risk.

DEBORAH METSGER

Represented on the penny, on the flag, and on the jerseys of the hockey team people either love or hate, the maple leaf has been a prominent Canadian symbol for more than 300 years. If you live in Canada, it's pretty difficult not to know what a maple leaf looks like. Long before 1996, when the maple was officially designated Canada's arboreal emblem, it was popularly considered our national tree.

Despite the generalized designation—the emblem actually refers to the maple genus *Acer* rather than to any particular Canadian species—and the stylized maple-leaf symbols that abound, there are actually 10 different species of maple native to Canada. Each has a distinct appearance, occupies a unique ecological niche, and contributes singularly to the biodiversity of the regions in which it grows. And lest you think otherwise, maples are not unique to Canada.

Woody plants of the family *Aceraceae*, all maples have leaves and branches that grow in opposite pairs. Among species, the foliage can vary from single leaves with smooth edges to compound leaves divided into many leaflets. The leaves we typically think of as "maple-shaped" have major veins that branch from the leaf base and end in lobes like the fingers on a hand. Maples are distinguished by their dry, winged fruits, called keys, which are adapted for dispersal by wind. The single-seed fruits grow in pairs and often split apart as they spiral to the ground.

BRIAN BOYLE, ROM

Worldwide, 100 to 150 different species of maple grow naturally as trees or shrubs in northern hemisphere regions with temperate climates. Thousands more horticultural varieties have been developed from a few of the world's favourite species. The highest concentration of pure species is found in Asia, especially China and Japan. By contrast, only 13 maple species are endemic to North America. Six of these are native to Ontario, where they play a major role in the forest ecosystems (see "Ontario's Maples," page 12).

Most of the maples sold in Canada as yard or street trees are not native, originating instead in Asia or Europe. Among the most popular are pure and horticultural varieties of Japanese maple (*Acer palmatum*), Amur maple (*Acer ginala*), and Norway maple (*Acer platanoides*). Japanese and Amur maples are preferred for their aesthetic qualities, especially the Japanese maple's many dwarf garden varieties.

The most common of the urban maples is the Norway maple. For years it was the preferred planting for urban streets, public parks, and gardens, not just in Toronto but in most North American cities. With its high tolerance for pollution, heat, and compacted soils, the Norway maple performs better in urban and suburban environments than do native species. It produces leaves earlier and stays green longer than many of its local relatives with the pleasing effect of appearing to

Cypriot Horse from a terracotta horse
7th century B.C.

Members $79.20
(Regular $88.00)

Royal Ontario Museum
(416) 586-5896
www.rom.on.ca/shops/repro

ROM Reproductions Shop

Authentic Reproductions from the ROM's own Collections

Gifts for the Holiday Season

Design: Chris Nicholson

Experience our World

- North India and Nepal: Rajasthan and the Himalayas
- Oman and the U.A.E.: In Search of Sindbad
- Jordan and Israel: Levantine Odyssey
- Australia: The Red Centre~Dreamtime
- Chicago: An American Metropolis
- Georgian Ireland: Homes and Gardens
- Newfoundland: Rugged and Unspoiled
- Korea and Japan: Past and Present
- Berlin and Dresden: History, Art, Architecture
- Santa Fe: Unique Culture and Cuisine
- Ancient Egypt: Heir to a Fabulous Past
- Antarctica: The Falklands and the Valdes too!

As advertised in *ROM Members' News.*

For further information or a brochure, call **ROM Travel**
(416) 586-8034

Organized by
The Department of Museum Volunteers
- Royal Ontario Museum -

ROM TRAVEL

extend our short summers. Cultivated in various forms and leaf colours, including the popular Crimson King, Globe, and Harlequin varieties, all Norway maple trees produce dense shade.

In recent years, however, this once-loved alien has been branded "invasive" and is now considered a threat to native habitats across North America. Introduced from other regions or continents, invasive species are those that out-compete native vegetation once they become established in natural areas. This imbalance alters the area's natural populations and reduces the overall biodiversity.

Norway maple and Manitoba maple, both invasive species in Ontario, are prolific seed producers and spread easily. Norway maple is a problem in upland forests. Pure stands of the species can replace the diverse, native sugar maple-beech forests, and the resulting dense shade kills native woodland wildflowers and tree seedlings. All that is left on the forest floor is bare soil subject to erosion and colonization by invasive herbs such as garlic mustard. Manitoba maple (*Acer negundo*) is not native to Ontario but has migrated here from other regions of Canada. It is very tolerant of disturbance and its seedlings and saplings are common urban weeds. When the species becomes established in floodplain forests it displaces sycamore, elm, and silver maple, in turn affecting the wildlife that depends on those trees for survival.

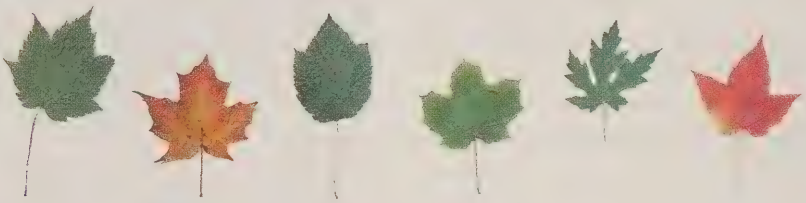
As with any problem, awareness is the first step toward a solution. *Trees in Canada* by J. L. Farrar (Fitzhenry & Whiteside and the Canadian Forest Service, 1995) is an excellent field guide and resource book for those who want to learn how to recognize the different maples.

The next time you buy a tree, check the names on the nursery labels carefully. Remember that maples with red leaves in summer are not native red maples, they are likely to be a type of Japanese maple or a Crimson King. (Red maples have red leaves only in autumn.) The tree you think is a sugar maple may very well be a Norway

Ontario's Maples

OF THE HUNDREDS of species and horticultural varieties that are grown in Ontario, only six are native to the province.

The **sugar maple** *(Acer saccharum)* is a dominant canopy tree in eastern deciduous and mixed forests. It grows in rich, moist, upland woods, often in combination with beech or white pine. Both sugar maple, and **black maple** *(Acer nigrum)*, which grows predominantly on flood plains, are commercial sources of maple syrup. Red or **swamp maple** *(Acer rubrum)* and **silver maple** *(Acer saccharinum)* grow in swamps and lowlands. These two species are among the first to flower in late March or early April and are considered indicators of spring's arrival. **Mountain maple** *(Acer spicatum)* and **striped maple** *(Acer pensylvanicum)* are shrubs that inhabit woodlands with cool, moist, well-drained soils.



BRIAN BOYLE, ROM

From left to right: mountain maple; sugar maple; striped maple; black maple; silver maple; red maple in autumn colours.

maple—their leaf shapes are quite similar. The most reliable way to tell the difference is by their sap. Norway maple has a white, milky sap, visible by breaking off a leaf. Manitoba maple, also known as ash-leaved maple, is the only North American maple species with leaves like those of an ash tree. The leaves may be divided into three to nine leaflets.

If you want to plant truly native species, it is best to search for pure species rather than using cultivated varieties. This is not always an easy task. Cultivated varieties of plants are often hardier and easier to produce. Unfortunately, because the demand for native species is still relatively low, few commercial nurseries stock them. Hopefully this will change as interest in native plant gardening and ecological restoration increases.

In the meantime, the Ontario chapter of the Society for Ecological Restoration has produced the helpful *Native Plant Resource Guide for Ontario*. This booklet, available through the Ontario Ministry of Natural Resources, not only lists suppliers, but also contains useful guidelines on how and why to use native plants. There are also many other good books available on the topic. For information on invasive plants in Canada, a good source is Environment Canada's 1993 publication *Invasive Plants of Natural Habitats in Canada*. A Web version can be reached from the Invasive Plants of Canada Project's Web page at http://infoweb.magi.com/ehaber/ipcan.html.

If you do buy a potentially invasive species, remember that maple seeds are dispersed by wind. The trees should be planted only in settings far removed from natural areas. City planning councils are now beginning to ban Norway maple from public parks and roadways. Homeowners should take the same precautions. After all, your garden is a habitat in itself. Choose a tree that matches your environment, and think Canadian.

Deborah Metsger is assistant curator in the botany section of the ROM's Centre for Biodiversity and Conservation Biology.

LIFE ON EARTH | PEOPLES OF CANADA | CULTURE, ART AND DESIGN

Earth and Cosmos

Toronto's Ravines: Walking the Hidden Country

By Murray Seymour
(Boston Mills Press, Paper: $19.95)

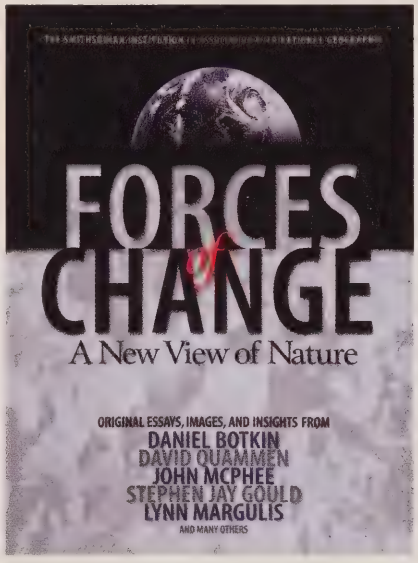
JUST SOUTH of the original yellow-brick ROM, several University of Toronto buildings lie in what was once a wooded hollow, and later a garden sanctuary, the location of a Great Horned Owl sighting in 1929. To the immediate west, the elevated Philosophers' Walk meanders above Taddle Creek (now coursing invisibly through a subterranean pipe). Strolling sages may still discern the lines of its ravine.

Seymour's tours of the city's extant ravines are keyed to its six significant inland waterways—the Don, Humber, and Rouge rivers, Highland, Mimico, and Etobicoke creeks. Local historical detail is abundant. The wetlands at the mouth of the Rouge, for instance, were once the site of a planned "Venice of the North," the intricacy of the river delta a factor of man-made canals. (One does, however, see more canoes there than gondolas). Seymour's trails wend through urban savannah and jungle, his wild-in-the-city approach alert to floral and faunal mystery. This concise compendium of lure and lore should find an honoured place in every backpack.

FEATURE REVIEW

Forces of Change: A New View of Nature

By Stephen J. Gould et al.
(Smithsonian Institution/National Geographic, Cloth: $58)



"IF BY SOME FIAT I had to restrict all this writing to one sentence, this is the one I would choose: The summit of Mount Everest is marine limestone." (John McPhee in *Forces of Change).*

In this integral collaboration of two august institutions, more than 20 of the world's most prescient and iconoclastic scientists and writers—Daniel Botkin, David Quammen, Lynn Margulis, and many others—explore the planet's natural phenomena as tightly interrelated and interdependent, viewing Earth as "a grand network of life-supporting forces operating within a single dynamic system."

It would be presumptuous to ascribe all change—especially deleterious—to humanity's interaction with the blue planet. In the Sahara Desert, ancient rock carvings of giraffes bespeak the area's lush past; American drought summers of the late 20th century were inconsequential compared with the drought that triggered the "dust bowl" of the 1930s, itself inconsequential compared with the prehistoric drought that created the sand dunes of present-day Nebraska.

Many of the forces of change are organic, planetary, even universal; the fossils of primeval sea-bed creatures can comprise the peaks of the world's tallest mountains; a future Hawaiian Island, rising steadily, sits 3000 feet below the ocean's surface. The past 4.6 billion years have been characterized by intermittent global warming and cooling, as well as by five major extinction events. The only constant has been change.

That is not to say that humanity's impact is negligible. Coral reefs are under global assault. In the desert sands of Russia's shrinking Aral Sea—the rivers that feed it diverted for irrigation—camels stride past beached and rusted scows. In Massachusetts, miasmata from the once-toxic Nashua River blackened buildings; in Ohio, the Cuyahoga River caught fire.

The true value of *Forces of Change* is its multiple-perspective analysis of cosmic, natural, and human activity, leading ultimately to a new, balanced, and more enlightened view of nature and the future of Earth.

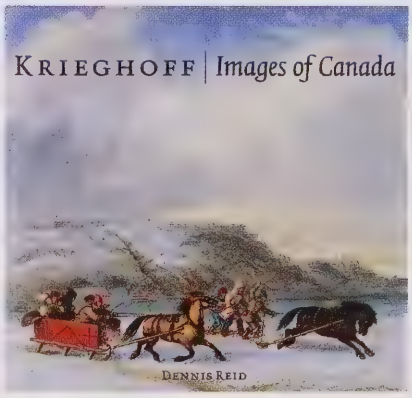
BRIAN BOYLE, ROM

COMPILED AND REVIEWED BY GLEN ELLIS

Krieghoff: Images of Canada

By Dennis Reid et al.
(Douglas & McIntyre, Cloth: $85)

As a chronicler of the people of the land, their customs, and their seasons, Cornelius Krieghoff has few Canadian rivals. His Bruegel-meets-the-Limbourg-Brothers style conjures a world infused with merriment, if not always verisimilitude. His *habitants* seem perpetually engaged in some earnest purpose, propelling themselves forward in its pursuit (as often as not in red sleighs). By contrast, his First Nations figures are sedate and static. They seldom travel in numbers—if they travel at all—but they encamp often.



BRIAN BOYLE, ROM

His idiosyncrasies notwithstanding, Krieghoff is justifiably an icon of Canadian art. The undeniable and immense charm of his paintings—and their having been drawn from life, if not a mirror of it—have made them part of the fabric of Canada. Canadian school children of a generation ago, and more, encountered them in the same breath as quatrains about smoky hills and crimson forests, all part of our cultural legacy from the 19th century, before the country moved to the city.

This landmark (and lavish) work parallels the exhibition of the same name, mounted by the Art Gallery of Ontario and travelling to five Canadian museum and gallery venues between 1999 and 2001. The 152 stellar images draw primarily—necessarily—from the celebrated Thomson Collection, as well as other private and public holdings. The ROM's Krieghoff collection is well represented. In addition to the principal text by Dennis Reid, the book includes significant contributions by Ramsay Cook, François-Marc Gagnon, Raymond Vézina, and the ROM's curator of Canadian historical art, Arlene Gehmacher.

The Mystery of Time: Humanity's Quest for Order and Measure

By John Langone
(National Geographic, Cloth: $52)

"The hunter knew only that the seasons change, the herds move on, and winter is nigh. It was all one needed or could ever hope to know of time."
—Historian Gale E. Christianson

"Perhaps the biggest surprise of the past decade is that it is not obvious that the laws of physics forbid time travel. There are many other types of theoretical solutions in general relativity that would allow time travel to the past."
—Physicist William A. Hiscock

The imminence of the third millennium has thrown a spotlight onto the topic of time. This remarkable volume weaves together the threads of myriad cultures' perceptions and interpretations of this temporal-celestial subject. The images are a delight, sometimes starkly dramatic, sometimes haunting: a 16th-century woodcut ship navigates through a sea of stars; mists swirl about the ceremonial circle of stones at Avebury, England; in a mesoamerican mural a dancer celebrates the planet Venus as a male god; an Aztec sun god radiates from the centre of a colossal stone calendar. The ancestor of all clocks, Su Sung's great astronomical tower, completed in 1092 as a memorial to Chinese Emperor Zhe Zong, incorporated a five-storey pagoda. Through its doors a procession of wooden manikins rang bells, pounded on drums, and—like starlets at a prize fight—displayed signs marking time's intervals. A counterpoint of topical features includes "Time's Great Thinkers," from Pythagoras and Ptolemy, through Galileo, Newton, and Einstein, to Stephen Hawking.

The Sky is Not the Limit: Adventures of an Urban Astrophysicist
By Neil de Grasse Tyson
(Doubleday, Cloth: $35.95)
Neil de Grasse Tyson, director of New York's newly recreated Hayden Planetarium, grew up in the Bronx and began his observations from the propitiously named Skyview Apartments. His memoir is richly anecdotal, sometimes more comic than cosmic. Recalling the frequent constabulary visits to his Bronx-Skyview observatory, he comments that he never met a policeman who wasn't fascinated by the rings of Saturn and the moons of Jupiter. The book concludes with a whirlwind guide to the future of the universe.

ALSO RECOMMENDED

The Variety of Life: A Survey and a Celebration of All the Creatures that Have Ever Lived
By Colin Tudge
(Oxford University Press, Cloth: $69.95)

Ancient Greece: From Prehistoric to Hellenistic Times
By Thomas R. Martin
(Yale University Press, Paper: $15.95)

Passionate Vision: Discovering Canada's National Parks
By Roberta Bondar
(Douglas & McIntyre, Cloth: $60)

The Geometry of Love: Space, Time, Mystery, and Meaning in an Ordinary Church
By Margaret Visser
(Harper Collins, Cloth: $35)

COMING IN THE SPRING 2001 ISSUE

ROTUNDA

Cat Conundrum

ROM palaeontologist Kevin Seymour searches for clues about how South American cats are related.

Imagining Buddha

बुद्ध

939.17.18

Some of the first images of Buddha in human form came from Gandhara, as did this work in schist from the 2nd to 3rd century AD.

In Pakistan, a branch of the ancient Silk Road survives still. Leading west from the modern-day city of Peshawar, it meanders through the Peshawar Valley toward an area I had long wanted to visit. In ancient times the region was known as Gandhara. Back then, monasteries and dome-shaped shrines called *stupas* lined this part of the Silk Road. Today, there are few visible Gandhara remains. But the sense of history was palpable as my driver and I passed through towns known to the merchants, traders, and pilgrims of antiquity, and to the invading forces of successive empire builders that travelled this route long ago.

I had hired a car and driver in Peshawar for three days of exploring archaeological sites dating from the 1st to 4th centuries AD, during the Kushan era. As an independent

Along the fabled Silk Road lay Gandhara, an ancient region that played a central role in one of Asian art history's most extraordinary developments.

researcher and art historian I particularly wanted to explore the renowned monastery Takht-i-Bahi. The October morning was misty and cool and the valley lush with fields of sugar cane, tobacco, corn, and wheat. We stopped to buy persimmons from the harvest being brought in by villagers, and it seemed worth the trip just to savour the creamy, freshly picked fruit.

Since the mid-1980s, when I began researching the Kushan-era arts in Central Asia, I had wanted to visit the isolated monastery nestled in the northwest of the Peshawar Valley, the heart of Gandhara. Takht-i-Bahi is one of a handful of partially excavated and restored monasteries of particular importance in the early history of Buddhist art. What drew me to Gandhara was the central role it had played in one of the extraordinary developments in Asian art history: the region shares the distinction with Mathura, India, of producing the first images of Buddha in human form.

Some of the most important Buddhist art in the world comes from the school of art established in Gandhara, and Takht-i-Bahi is the source of the finest examples of

939.17.13

939.17.8

Left: Typically the Buddha was shown in lotus position or in walking meditation as here. Right: Images of princely and richly attired figures called bodhisattvas also became popular.

By David Jongeward

Sculpture photography by Brian Boyle

sculpture from the Gandhara school. Many pieces now treasured by a number of the world's major museums, including the Royal Ontario Museum, were originally created for Takht-i-Bahi's temples, *stupa* complexes, and courtyards.

TAKHT-I-BAHI PHOTOGRAPHS BY USMAN ERDOSY

A kitchen and dining hall overlook the quadrangle at Takht-i-Bahi, one of the largest and best preserved of the ancient Gandhara monasteries.

Although the place name has not survived, Gandhara in its day was widely known throughout ancient Persia and India. The region was a square of land about 160 kilometres (100 miles) across, covering areas that today form part of northern Pakistan. Gandhara sculpture, which is almost exclusively Buddhist in subject matter, has been unearthed from a much larger area, ranging from Afghanistan and northwest China to as far south as Mathura, India. Incredibly, the school was active for more than seven centuries, from approximately the 2nd century BC to the 6th century AD.

The origins of the style are obscure. It is likely, though, that it began with the Bactrian Greek civilization. At first glance, some Gandhara sculpture does look Greek. This may seem unexpected, even strange, for an artistic tradition rooted in Indian religion thousands of miles from the Mediterranean. But Greek art and culture came to influence Central Asia through Alexander the Great's conquest of Persia and his expedition in 328 BC to areas that are now Afghanistan, Uzbekistan, and Pakistan. After Alexander's death in 323 BC, Greek rule did not last long in India, but north of the Hindu Kush an independent Greek kingdom called Bactria emerged about 255 BC. The Bactrian Greeks created an urbanized civilization that flourished for more than a century before it was overrun by invading Yuezhi, Scythians, and Parthians.

After the fall of Bactria, Gandhara art continued to be produced under Scythian and Parthian rule, flourishing during four centuries of Kushan rule, and surviving, into the Gupta and post-Gupta periods in the 4th and 5th centuries.

In the dusty town of Charsada, we stopped for a look in the local shops. The busy market area's narrow lanes were not designed to handle the crush of modern trucks and cars so we got out and walked. I found a tiny shop with interesting old coins in the window. At the door I removed my shoes and was greeted by the bearded shopkeeper in the customary Muslim manner—a bow combined with the right hand raised across the heart. He invited me to make myself comfortable on a fine Turkoman carpet from northern Afghanistan. He served tea and chatted awhile, an everyday aspect of shopkeeping in this part of the world, before getting down to business. He produced a big bowl full of ancient coins, many of which were badly corroded and worn—unsuitable for collectors but of great interest to me. I held in my hand pieces of history unearthed from nearby fields and ruin sites. There

were Bactrian Greek, Parthian, and Kushan issues. I was delighted to find a good bronze coin minted by the most famous of Kushan kings, Kanishka the Great, for about $6.

Located near the Kabul river, a tributary of the Indus river system, Charsada was once the capital of Gandhara in Kushan times, under the name Pushkalavati. But because the river's course shifted periodically in those days, flooding the city, the capital was moved to Peshawar in the second century AD, probably by Kanishka.

It was in the Kushan period that Gandhara art reached its zenith, enjoying patronage from Kanishka and likely from the local Indian nobility, some of whom had converted to Buddhism. The Kushan were a Caucasian people who spoke an Iranian language. They had emerged from the Central Asian nomadic tribesmen known as the Yuezhi. In 30 AD, the Yuezhi tribal chief Kujula Kadphises declared himself king and minted coins bearing his family name, Kushan. Kujula expanded his empire from its origins in northern Afghanistan across the Hindu Kush and south and east into Gandhara. His son, Vima Takto, and grandson, Vima Kadphises, continued to expand deep into India. At its height, the Kushan empire was vast—much larger than present-day India—and controlled many of the towns and trading routes that centuries later would become known as the Silk Road.

Kanishka's 26-year reign, from about 120 to 146 AD, is considered a golden age in Central Asian and Indian history. It was marked not only by enormous wealth but by a flourish of creative activity. Major advancements were made in architecture, literature, and the arts. Under Kanishka, the Gandhara school achieved its highest levels of productivity, creating countless works in stone, wood, terra cotta, and stucco.

From Charsada, we took the road to Mardan, a military base established by the British in the early 1800s and now home to Pakistani regiments. We still had about 14 kilometres to go, northwest of Mardan on the Malakand Pass Road. A fading hand-painted sign, easily missed, indicated the turn-off. We crossed a railroad track and passed an old sugar mill, then followed a narrow, potholed road uphill for a mile or so beyond the last signs of habitation. As we approached the monastery site dark clouds and the light rain that was beginning to fall heightened the deepening sense of isolation.

A steep flight of stone steps led to the hilltop monastery, whose stone walls, obscured by clouds near the crest of a ridge, were barely visible. Leaving my driver with his car, I began the ascent, silently grateful for the cool drizzle; it would have been a much more formidable climb in hot sun. Another flight of steps led me directly into the monastery's central court. I had arrived at Takht-i-Bahi.

Even in the mist, the setting was spectacular, overlooking the villages and green fields of the Peshawar Valley and the stark rock of surrounding ridges. Two days later, when the weather cleared, I would discover that the Peshawar Valley road—and no doubt Takht-i-Bahi—offers magnificent views of the snow-and-glacier-capped Hindu Kush. But on the day of my visit, I saw only the monastery's 1.2-metre- (four-foot-) thick stonework architecture rising before me on misty slopes.

Top: The remains of votive *stupas*, their sculptural elements now missing, line the perimeter of Takht-i-Bahi's Court of Many *Stupas*. Bottom left: In meditation cells like this one, travelling monks would have taken sanctuary for study, meditation, and sleep. Bottom right: The steep flight of stone steps that leads up to Takht-i-Bahi.

बुद्ध

Rain had stained the rock walls and surrounding ridges a deep reddish orange tinted with yellow and mauve.

Takht-i-Bahi is one of the largest and best preserved of the Gandhara monasteries. Although its peak of activity coincided with Kushan times, its construction and occupation began at least a century earlier, probably in the first century BC. Within the century that followed, Takht-i-Bahi was to witness, perhaps facilitate, the emergence of the first images of Buddha represented in human form.

Representing the Buddha as a human figure may seem unremarkable today, but in Gandhara times the artistic innovation was a radical departure from tradition. Until then, artisans had intentionally chosen not to depict the historical Buddha, who lived from about 435 to 355 BC, in any artistic medium. In ancient—and modern—Buddhist belief, the Buddha represents the ultimate of all conceivable forms of existence, transcending the impermanent, fluctuating world of mere appearances. Buddha represents an ideal enlightened being, a state of immeasurable, unlimited liberation.

"A spot not too far from the town and not too near; suitable for going and coming; easily accessible to all people; by day not too crowded; at night not exposed to noise and alarm; clean of the smell of the people; secluded from men; well fitted for a retired life."

From an early Buddhist account of a favourite Gandhara retreat

Before the Gandhara and Mathura schools' anthropomorphic images began to appear, representations of Buddha are best described as symbolic. In sculpture panel reliefs, where the Buddha might be expected to appear, there is often a conspicuously empty space. In other portrayals, a footprint, a tree, a wheel, a throne, a turban, or a *stupa* were the favoured symbols to represent the Buddha's presence.

As I entered Takht-i-Bahi's expansive "Court of Many Stupas" I was impressed with the remains of votive *stupas* that line the perimeter. The sculptural elements that once enhanced the monuments are now missing, but it is easy to imagine the court walls embellished with stucco narrative and decorative reliefs. Surrounding the court on three sides are tall chapels with domed roofs, some of which are partially restored.

The *stupa* was the primary architectural form of early Buddhism and an important symbol of the Buddhist ideal. A hemispherical mound raised on a square base, the structure is surmounted by a mast and any number of umbrellas that decrease in size as they ascend skyward. The first Buddhist contructions were adopted from the Hindu Brahmanic tradition in which the *stupa* served as a burial mound.

Early *stupas* tended to contain ashes and relics of the Buddha, Buddhist saints, and disciples. Others were built to commemorate important events. A permanently sealed interior chamber in the *stupa* might also contain relics, coins, precious metals, crystals, gold boxes, and reliquaries in the shape of miniature *stupas*. These small replicas have served modern researchers as vitally important models of monuments that have been destroyed. *Stupa* temple architecture from Gandhara followed Silk Road routes, eventually reaching China and Japan, where it influenced local Buddhist architecture. There, the form was modified to become what is known in the West as the pagoda.

Precisely when and how artistic representations moved beyond the symbolic, and human images of Buddha came into acceptance remains unclear. Dateable evidence, such as coins, suggests that the artistic innovation probably took place sometime during the first century AD. Many influences at that time would have spurred new forms of expression. By the second century BC, the great cults of Hinduism, especially that of Shiva, were beginning to produce images of their own deity for popular worship. The Jains were doing likewise.

And there is little doubt that the Mathura school of sculpture in Mathura, India—which served the Kushan empire as a southern capital as well as a major trade and artistic centre—also played a major role in Gandhara artistic developments. The image of Buddha was a natural extension of the Mathura fondness for representing a variety of nature deities in human form. Scholars often ask whether Gandhara or Mathura was the first to produce images of the Buddha. The development was probably simultaneous, with each school influencing the other, as both enjoyed Kushan patronage on a grand scale.

These events in Buddhist art were un-

folding as the Kushan empire spread throughout Central Asia. Buddhism and Buddhist art followed traders and caravans, Kushan kings and warriors, into China, Kashmir, and western Tibet. Scholars now generally accept a long-standing suggestion that Kanishka the Great converted to Buddhism late in his life, even though his coinage suggests that the primary Kushan religion was an Iranian form of the Zoroastrian faith.

बुद्ध

939.19.1

Gandhara artists like the one who sculpted this bodhisattva in the 4th century were encouraged to search deeply to imbue their art with Buddhist values.

From Takht-i-Bahi's *stupa* court, I walked up another five steps to reach a spacious quadrangle surrounded on three sides by monks' cells. Originally, the monastery buildings were two stories high and would have accommodated about 30 monks. A kitchen and dining hall overlooked the quadrangle. I couldn't help wondering what it might have looked like in Kushan times. In the 6th century a Chinese pilgrim reported that Gandhara monastery pavilions displayed extraordinary art—free-standing sculpture, windows and partition walls painted in various colors, and beams and architraves ornamented with fine sculpture.

It was in places such as this that travelling monks would have taken sanctuary at the end of each day on journeys that might have covered hundreds of miles along the trails linking holy places in the mountains and valleys. Hilltop monasteries provided retreats for study, meditation, and sleep, and the courtyards may have been used for special exercises and movements that disciplined the body and mind. It is very likely that walking meditation as well as sitting meditation was part of Buddhist practice from ancient times. The meditative state was perceived as a Way of Being, a following in the footsteps of the Buddha.

The region surrounding Takht-i-Bahi is rich with monastery remains, signifying that this was likely part of "the ancient trail of the pilgrim route, over the hills and down the valleys, across the snowy peaks to the plateau of Gilgit, Ladakh, and Tibet and onward to the Land of the Rising Sun," as A. H. Dani noted in *A Guide to Takht-i-Bahi* written by Fidaullah Sehrai in 1986.

The proliferation of monasteries such as Takht-i-Bahi was a potent factor in the success of the Gandhara school of sculpture. In Kushan times, thousands of monasteries were constructed in Gandhara and neighboring areas. Each of these buildings would have commissioned appropriate decoration, creating a high demand for free-standing sculpture, ornamented doors, railings, columns, wall panels, and *stupa* complexes. Outside Gandhara, the sculpture also enjoyed huge popularity. Favourite images could be found in monasteries across the Himalayas, the Hindu Kush, and the Pamirs in Central Asia and northwestern China.

To keep pace with the ever-growing demand for images, Gandhara artisans experimented with materials other than stone and wood. Increasingly, they used stucco and terra-cotta in the later period of the Kushan era (3rd to 4th centuries), and large numbers of Buddha heads made from these materials have survived, especially from the Taxila area. In some respects, the new media allowed a change in the general treatment of the Buddha image, as softened and more graduated lines were made possible. Some of the faces in terra-cotta reveal a deep warmth and intense inner quietude.

939.17.17

939.17.15

Top: A group of worshippers are shown at a fire temple on this panel relief. In Buddhism, fire was a powerful symbol of life and light. Bottom: The Prince Siddhartha (Buddha-to-be) has left behind his turban and crest jewel, symbols of wealth and privilege, to go out into the world to seek enlightenment. This sacrifice is being celebrated by a group of musicians and a dancer.

Early Gandhara artists favoured scenes from the life of the Buddha. Later on, full-figure portraits became popular. Typically, Buddha was portrayed either sitting in the lotus position or in walking meditation, garbed in a simple monastic robe. It was also popular to portray bodhisattvas—the disciples or monks who had made a vow to achieve enlightenment but had postponed their own Buddhahood for the sake of helping others in their spiritual search.

Thirty or more years ago, art historians concluded that "Gandhara figures show only too obviously that they are derived from a prototype that was itself derivative, in which a large number of historical influences overlaid one another," as D. Seckel noted in his 1964 book *The Art of Buddhism*. Today, scholars view the multiplicity of influences in Gandhara art in a more positive light. In fact, the impact of Gandhara art lies in its profound synthesis of elements from the many cultural and religious traditions in the area at the time—Hellenistic, Roman, and Near Eastern art traditions, imbued with Indian and Buddhist thought.

To THE WEST of Takht-i-Bahi's quadrangle, a long, narrow passage surrounded by massively thick, 9-metre- (30-foot-) high walls that rise directly out of the hillside opens into another large courtyard. A series of stairs leads to the building's largest *stupa*. Only the first level of the base survives, but the original must have been a spectacular monument, given its 6-metre- (20-foot-) square base. Partially restored chapels surround the *stupa* on three sides, each one a separate building opening onto the court. Each, in ancient times, housed shrines and statuary in honour of saints, kings, and the Buddha.

There I met an on-site attendant who offered to take me to another part of the monastery. With his full beard, prominent nose, and angular features, he wouldn't have looked out of place among the Kushan kings whose portraits I'd seen on ancient coins. He led me to a series of vaulted chambers, partially carved out of the hillside. A central passage with 4.2-metre- (14-foot-) high corbelled arches gave way to a series of cells on both sides, some with small doors opening to the courtyard. Even after nearly two millennia it seemed an ideal place to sit quietly and ponder the silence of the hillside and valley. A familiar lament came to mind. If only the stones could talk. I wished I could hear stories about the centuries of active Buddhist

life that had occured in these courtyards and meditation cells.

We mounted another flight of stone steps that led out to the ridge summit, where I was rewarded with a rain-drenched, eagle's- eye view high above the monastery, the valley, and the surrounding hills. Without ceiling beams, roofs, and domes, the monastery's inner labyrinth of stone walls, passageways, and courtyards lay exposed.

Ancient planners chose mountainside locations for many monasteries in Central Asia out of practical consideration, to keep the buildings from interfering with village life or encroaching on arable valley land. Although fewer in number than rural monasteries, large, complex monastic organizations were integral to urban life in Peshawar, Taxila, and other cities. The monastery system supported the Gandhara art and literature of the time—which portrayed the Buddha as a teacher who travelled with his disciples to preach the doctrine.

In its own way, Gandhara sculpture captures many dimensions of the Buddhist ideals. Artisans, clearly, were encouraged to search deeply for Buddhist values that would transcend external influences. In the temples for which they were designed, the sculpture surely inspired master and monk. In their museum settings, the artworks still communicate powerfully.

At its best, Gandhara art succeeded in portraying Buddha and bodhisattva figures as compassionate and inward looking, infused with light and insight. Gandhara's artistic innovation, along with that of Mathura, transformed early Buddhism, creating the iconography for a more personal view of the Buddha, his life story, and his transcendent ideals. The art's immense popularity broadened Buddhism's appeal and contributed to its spread throughout Asia.

Fifteen hundred years after Takht-i-Bahi was abandoned, the hillside archaeological site, surrounded by a profound aura of silence, still inspires awe. It is as if the contemplations of the ancient monks, expressed in the art, linger still in Takht-i-Bahi's stone walls and empty courtyards.

The Secular Side of Gandhara

Though almost exclusively Buddhist in subject matter, Gandhara art does offer some exceptions to the rule. Two exceptional examples from the ROM's Far Eastern collections are these stair-riser reliefs, part of a set of 16, whose counterparts are found in museums in New York, Cleveland, Hartford, London, Peshawar, and Leiden. The first of the ROM's stair-risers depicts noble donors, distinctively Indian in appearance, their dress consisting of the *dhoti*, a turban, and a long scarf for the men, and elaborate hairstyles for the women. The second one depicts a woman about to drink from a wine goblet. She is accompanied by five men, three of whom play musical instruments while the other two keep time to the music. Their dress is Hellenistic. In the entire set of 16, there is great variety in the figures' dress and appearance, reflecting the multicultural nature of ancient Central Asia. The sculpting is beautifully conceived and rendered.

930.19.2

924.27.1

Stair-riser reliefs. Grey schist, Early Kushan period, 1st century AD.

By Francesco Santini
Illustration by Steve Adams

the heavens and the deep blue sea

Could life exist on other planets? Although it may seem unfathomable, the answer could lie within Earth's oceans.

When Giovanni Schiaparelli, a 19th-century director of the astronomical observatory in Milan, announced that he had discovered "channels" on the surface of Mars, the news was met with great clamour. Schiaparelli claimed to have seen geometric structures that changed shape and position through time. The fluctuations, he assured researchers, were caused by the activity of "laborious" Martian workers. Of course, the channels were later shown to be natural, and fixed, features of the red planet's surface.

Despite setbacks and embarrassments like Schiaparelli's, the search for extraterrestrial life was a challenge scientists couldn't resist. After all, for more

than 2000 years, philosophers and naturalists from every continent and civilization have pondered and speculated about the existence of living organisms in other worlds. And now, recent scientific discoveries—some from the depths of the Earth's oceans—are bringing answers closer than ever before.

During the 1970s, NASA launched a series of probes—the Viking project—to investigate whether traces of life as we know it existed on the surface of Mars. When these expeditions failed to detect any sign of biotic activity on the red planet, the news reinforced a belief already advanced by British scientist James Lovelock, a former scientific advisor on the Viking Project, that there is no life on the other planets in our solar system.

Lovelock had examined the composition of the inner planets' atmospheres—those of Mercury, Venus, Mars, and Earth—and noticed that whereas Earth's is dominated by extremely reactive gases, the atmospheres of other planets are composed of massive concentrations of non-reactive gases, such as carbon dioxide. According to Lovelock, Earth's very different atmosphere is a direct consequence of the presence of life. Life itself drastically alters its surrounding environment by emitting highly reactive gases—such as molecular oxygen and methane—as the byproducts of biological function.

Lovelock therefore reasoned that the presence of life should be easily detected simply by observing a planet's atmosphere. That the atmospheres of our solar system's other planets and planetoids are rich in non-reactive gases (a state called thermodynamic equilibrium) he interpreted to indicate the absence of life.

After the disappointing results of the Viking missions, the search for life in the universe shifted from exploration with probes to scans of the sky using radio telescopes. The Search for Extra Terrestrial Intelligence (SETI) project, conceived and nurtured in the 1960s by a group of American scientists, including the late astronomer and writer Carl Sagan, uses powerful radio telescopes to identify radio signals that might be emitted by alien civilizations. So far, none of the SETI groups has located such a signal.

But what SETI has managed to do is to play a major role in furthering the field of bioastronomy—the science related to the search for other life forms in the universe. It was SETI that influenced the International Astronomical Union's decision in 1982 to create the Committee for Bioastronomy. This international group, which includes some of the world's most brilliant scientific minds in fields as diverse as astrophysics, biochemistry, electronic engineering, and marine ecology, meets every three years to share information, research, and ideas.

More than 200 scientists attended the most recent meeting in Kona, Hawaii, hosted by the University of Hawaii in the summer of 1999. Some extraordinary developments were reported: for the first time planets have been identified outside our solar system; new discoveries have been made about the Earth's chemical composition before life existed here and about the chemistry of meteorites and asteroids; and new ideas about molecular biology and the origin of life have been developed.

Until 1995, no extrasolar planets — those beyond our own solar system — were known at all. In the last five years, about 20 new planets have been identified. That number is sure to increase.

Any form of life requires a planet with specific features. First, it must have the proper physicochemical characteristics to host life—the presence of water, temperatures above water's freezing point but below its boiling point, and so on. Until recently, Earth was the only planet known to have such properties. But until 1995, no extrasolar planets—those beyond our own solar system—were known at all. In the last five years, about 20 new planets have been identified, and this number is sure to increase. So far, all of them are the Jovian type—gaseous rather than rocky like the Earth or Mars—and therefore not apt to host carbon-based life forms similar to those on Earth. But the gas giants are much easier to spot than smaller Earth-like planets. Constant improvements in identification techniques increase the probability of finding planets similar to our own.

A second basic requirement of life is the presence of amino acids, the chemical building blocks that constitute the basis of all known biological structures. In the last few years research groups throughout the world have found that most meteorites contain amino acids. In the Murchison meteorite, one of the most studied examples, 55 amino acids were found, including 8 of the 20 involved in the formation of normal proteins.

Third, any planet hosting life must contain carbon, hydrogen, oxygen, and nitrogen—which form the basic constituents of all organic structures. These elements are also very abundant in meteorites and comets. Several researchers have suggested that the majority of the carbon and water found on Earth today may have arrived from outer space between 4.5 and 3.8 billion years ago. During that time, called the period of lunar

the
eavens
nd the
deep
ue sea

bombardment, our planet was hit by hundreds, if not thousands, of comets and meteorites.

Scientific knowledge about pre-biotic chemistry—the Earth's chemical composition before life existed—has also increased dramatically in the last few years. Recent research suggests that the physicochemical conditions likely to have prevailed on planet Earth during its early stages are also likely to have occurred on other planets in the solar system. To date, there has been much speculation but no convincing hypothesis to explain why, if all the planets originally had water, only Earth was able to maintain its hydrosphere.

Contrary to the scientific community's long-held belief that life is highly coincidental, produced by a series of unlikely events, new theories of chemical self-organization suggest that life could very well have originated from casual but complex chemical interactions. Over the last couple of decades several scientists have suggested that very simple molecules could spontaneously interact according to basic chemical laws, thereby catalyzing reactions to produce more and more complex structures, or proto-cells, from which living, self-reproducing cells eventually emerged. New techniques of molecular biology now allow empirical testing of these speculative theories, and, given the number of labs involved in this research worldwide, it seems only a matter of time before someone manages to produce "life in a cuvette." Based on the preliminary results, more researchers are coming to believe that finding proto-biological structures on other planets is much more likely than was previously thought.

While all these advances in knowledge have intriguing implications for bioastronomy, the most exciting discoveries, at least in my opinion, have come from the study of some deep-sea environments. Surprisingly, they may point most tellingly to the likelihood of life on other planets.

I first became interested in bioastronomy in 1995 as an undergraduate student in biology at the University of Pisa, Italy. My former supervisor, Lodovico Galleni, is an expert in speciation of marine organisms and has a fascination with community ecology. For my undergraduate thesis project, he had me attempt to produce mathematical models that could simulate the dynamics of interaction among marine biological populations, taking into account the influence organisms have on their environment, and vice versa.

I chose to base my models on the deep-sea hydrothermal vent. In 1977, Robert Ballard (later to become famous as the discoverer of the *Titanic* and the *Bismarck*) and his colleagues discovered the first hydrothermal vent field, with its incredible biological community, several thousand feet below the ocean's surface near the Galapagos Islands. Several more vent fields and their associated fauna have since been found throughout the Earth's oceans, especially in ridge areas where tectonic plates are created.

The biomass—the total mass of all living organisms—in these peculiar thermal vent ecosystems may exceed 70 kilograms per square metre (154 pounds per square yard), whereas the average in deep-sea ecosystems is only a few grams of biomass per square metre (less than half an ounce per square yard). It was immediately apparent that the biological community must be powered by a source of energy other than photosynthesis.

The more I learned about these ecosystems, the more I realized their great application to bioastronomy. The presence of these life forms deep in the ocean, away from any source of solar light, turned Lovelock's assumption on its ear—looking at a planet's atmosphere may not accurately indicate the presence of life, after all. Life can exist in the ocean, leaving no traces of its presence on a planet's surface.

The question that remained was, How can this be possible? Researchers looked to the nature of hydrothermal vents for answers. The phenomenon is produced by the same geological processes that cause volcanism and drive plate tectonics. When marine water penetrates the Earth's crust through a vent, it comes in contact with magma at extremely high temperatures. The heat severely modifies the water's properties so that when it re-enters the ocean, it may have high levels of carbon dioxide and a temperature of up to 400° C, and it may be rich in inorganic compounds—those not formed by carbon atoms—such as hydrogen sulphide.

Instead of relying on photosynthesis, the biological communities living in thermal vent ecosystems depend on bacterial chemosynthesis—the process by which bacteria use the oxidation of inorganic compounds, rather than solar light, to produce carbohydrates from carbon dioxide. The primary source of energy for these communities is not solar light, which powers photosynthesis, but geothermal energy—the chemical energy obtained from compounds produced in the Earth's interior.

Chemosynthetic bacteria are the only primary producers in thermal vent communities—as are plants in photosynthesis-based communities like our

own. These bacteria form the base of the trophic, or feeding, structure—in other words, they are the anchor at the bottom of the food chain. The remainder of the communities are made up of other bacteria, protists (unicellular organisms), and several species of invertebrates, such as two-metre- (78-inch-) long tubeworms and mussels that measure up to 30 cm (1 foot) and can weigh more than a kilogram (2.2 pounds) each.

The inhabitants of hydrothermal vents are unique to and taxonomically distinct from the fauna typical of the deep sea. Most of them are new to science. Symbiotic associations between bacteria and the invertebrates in these communities allow organisms, such as the peculiar and mouthless *Vestimentifera* tubeworms, to reach sizes otherwise barely conceivable in such an energy-poor environment. Many of these discoveries have been made by Canadian marine biologists who have historically been at the forefront of research into deep-sea communities. The ROM houses a collection of fauna from vent communities.

Isotope analysis performed by research labs in North America, Europe, and Japan, reveals that almost every chemical compound used by the chemosynthetic bacteria in vent communities has a mainly geothermal origin. This means that when a vent stops emitting thermal fluid, the biological community disappears. Without the fluids rich in reduced chemical compounds, the bacteria cannot carry out chemosynthesis, and without these primary producers, the entire community dies of starvation. The new biological community that replaces it, dependent for its survival on the scarce food that drifts down from the surface of the sea, has the much lower biomass typical of the deep sea.

The discovery of these life forms deep in the ocean, away from any source of solar light, turned scientific assumptions on their ear. The question that remained was, How can this be possible?

Biological communities similar to the ones living in vent fields have also been discovered in association with cold seeps—openings in the sea floor from which hydrocarbons flow—where the reducing conditions are provided by the hydrocarbons. Other high-biomass communities have been identified at the base of the Florida escarpment—where, thanks to the deep-sea currents, fluxes of reducing and oxidizing sea water mix—and in cold springs off the Oregon coast. Recently, vent-like communities have also been observed surrounding the carcasses of decomposing whales. It is now believed that marine biological communities based on bacterial chemosynthesis are common in the deep-sea environment.

While scientists knew about biological communities that depend, at least in part, on chemosynthesis many years before Ballard's discovery—such as the microorganisms found in hot springs—in these communities, photosynthetic organisms have also been present to contribute to the ecosystem's energetic balance. The Galapagos hydrothermal vents provided the first evidence of ecosystems that depend more heavily on an energy source other than light.

Yet the independence of vent organisms from sunlight is not total. Molecular oxygen remains a fundamental compound for the vast majority of known chemosynthetic reactions, and on Earth, molecular oxygen is produced only through photosynthesis—which happens only on Earth's surface. We know, thanks to probes such as the Viking series, that no planetary biospheres except the Earth exist in our solar system. Life may nevertheless be able to survive in confinement and isolation for long periods of time where there was once a biosphere.

In this respect, Movile Cave represents an even more fascinating case study for bioastronomers. Located in Romania near the coast of the Black Sea, the cave hosts a biological community that, until its discovery in 1986, had remained completely isolated from the external biosphere for at least half a million years. Fallen rocks together with wind-borne grains of sand had completely sealed the cave's opening. The only source of matter and energy for the community inside was the heated fluid of several hot springs that enter the lower part of the cave.

This thermal fluid provides inorganic compounds that can be used in chemosynthetic reactions by some bacteria. The complex and peculiar community of fungi, insects, spiders, carnivorous leeches, and crustaceans relies on these bacteria for its source of energy. Proof of the cave's complete isolation from the external biosphere lies in the lack of stalactites and stalagmites (which shows that there is no leakage of water from the top of the cave) and in the absence of radioactive pollution from the Chernobyl accident, which is present in every other cave in the area.

Although the Movile Cave community still presents a considerable mystery to science, it reveals that a complex biological community may persist for long geological periods of time in a small habitat, provided that a source of energy is available. Previously it was thought that life required a habitat of planetary di-

mensions to obtain all the resources to support itself. Movile Cave is a true microbiosphere and, in the opinion of many researchers, counterparts could exist in restricted areas beyond the Earth.

At this point, those sceptical of the life-beyond-Earth possibility may argue that, even in isolation from a solar energy source, life still requires water and some kind of geothermal energy source, as do the organisms found in hot springs and deep-sea vents. And if neither water nor magma exists on other planets or planetoids, wouldn't this be good evidence against the presence of life? Not according to recent discoveries in microbial ecology.

In recent years a great number of chemosynthetic microbial communities have been found up to four kilometres (2½ miles) inside the Earth's crust. They survive extremely high pressures and temperatures in the absence of magmatic activity and, in some cases, in the almost complete absence of water. It now seems that certain microorganisms—bacteria and archea—can live almost anywhere there is a source of energy. They can survive temperatures up to 115 °C and pressures hundreds of times what we experience on Earth's surface—even higher than those exerted on submersibles diving into the ocean's deepest trenches. They use metabolic pathways—the cycles of biochemical reactions that produce food and energy—that were unimaginable until their discovery.

It is very likely that these communities inside the Earth's crust could survive even the worst catastrophic events, such as comet or asteroid impacts, which might wipe out all life forms on the Earth's surface. Deep-sea vent communities might also be able to survive such events. There is much speculation that heat-loving bacteria may have already done so during the period of lunar bombardment.

Scientists recognize that life on our planet may have originated in a hydrothermal environment, and that complex biological communities have been able to emerge and adapt to life independent from the external light-based biosphere in peculiar habitats, such as Movile Cave. Given this, couldn't the same have happened on other planets and planetoids, even within our solar system?

While the search for inhabited planets beyond our solar system is still on, much attention is currently being devoted to Mars and to a few planetoids in our own solar system. Data gathered from the Galileo probes, which NASA launched to explore the outer planets of our solar system, have shown that there is volcanic activity on at least three of Jupiter's moons—Io, Europa, and Ganymede—and on at least one of Saturn's moons—Titan. In addition, Europa and Ganymede have oceans of water and detectable concentrations of molecular oxygen. The probes Voyager I and II have shown that Titan's atmosphere is composed mostly of molecular nitrogen, the only such case in our solar system outside the Earth. Titan is covered in oceans of liquid methane and ethane, over which continents of ice could be floating.

Among Jupiter's satellites, Europa has always been considered the most interesting. It is a dense body, largely composed of silicates and entirely covered by an ocean of liquid water up to 100 kilometres (62 ½ miles) deep. The ocean is itself covered by a 10-kilometre-(6.2-mile-) thick ice crust, and has an average temperature of about 4° C. The existence of liquid oceans on Europa is probably due to tidal action, which would cause the ice to melt. It is considered very likely that hydrothermal vents are present on the bottom of Europa's ocean floors. Future missions from NASA will concentrate on how to explore these vents.

Even within our own solar system it seems there are several likely candidates to host extraterrestrial life. And there may also be planets that hosted life in the past. We now know that Mars, during the early stages of its existence, must have been very similar to early Earth, with oceans of water and intense volcanic activity. In 1996, NASA made the astonishing announcement that traces of possible biotic activity had been found in the Martian meteorite AH84001. The news shocked and divided the scientific community. In the past two years, many doubts have been raised about the biological origin of the AH84001's sulphides. However, even if the fossil bacteria in this meteorite should turn out to be false—perhaps the product of chemical reactions leaving impressions that look like those of fossil bacteria—the amount of information gathered in recent years about the early geological history of Mars and about the possible mechanisms involved in the origin of life on Earth still make the red planet a primary candidate in the search for extinct forms of life.

The search for life in the universe poses a scientific challenge with few equals, and its philosophical implications could be even more profound than its scientific merits. While we do not yet have absolute proof whether life exists or may have existed on other planets, the latest evidence suggests that it may only be a matter of time before we know for certain. ■

43RD PARAL

PHOTOGRAPHY: GARY CRAWFORD

Seaweed is harvested in Minamikayabe, Japan.

"Why Japan?" is one of the most common questions my students and Japanese colleagues ask about my overseas archaeology work. If you were to read my research publications you might think that I simply had academic questions to answer. That's close to the truth, but it's not the whole story behind what has held my interest in Japan's prehistory for more than 25 years.

To me, a *gaikokujin* or outsider, northern Japan was at first impossible to understand but seductive in its mystery, depth of spirituality, and complexity of tradition. Yet I felt, and still feel, remarkably at home there. Like most western archaeologists, my approach is comparative: I look at similarities and differences in order to help me interpret the archaeological record. I can't help but feel that part of my comfortableness stems from the surprising parallels that exist between the prehistories of northern Japan and Ontario.

Superficially, the cultural histories of the two are dissimilar enough that comparison seems futile. Japan during prehistory is unusual in several significant ways. The earliest pottery in the world emerged there, for example, as did the largest non-agricultural communities anywhere in the world between 8000 and 3000 years ago. On closer inspection, though, the par-

By Gary W. Crawford

LELS

At first glance, northern Japan and Ontario would appear to have little in common. But one archaeologist has unearthed uncanny similarities.

The Manitoulin shoreline. While Ontario is not an island like Hokkaido, it is surrounded on three sides by water.

allels that emerge suggest a deeper, sometimes uncanny, commonality between our peoples.

I was first invited to Japan by the late Bill Hurley, a professor I had been working with as an undergraduate student in Toronto. While studying biology and archaeology, I became interested in palaeoethnobotany—the study of the relationships between plants and people in the past. This extraordinary invitation to research plant use and the palaeoenvironment of the early people of Hokkaido was one I couldn't refuse.

When I stepped off the plane in Japan for the first time, I was full of apprehension. Although I had read most of the English-language literature then available on Japanese archaeology, there was just not that much of it. And nobody had seriously researched archaeological botany in Japan before, so I was starting from scratch.

One of the first things I noticed was that the environment in Hokkaido, Japan's northernmost prefecture, is quite similar to southwestern Ontario's. Both places lie at the same latitude and are about the same size. Hokkaido's vegetation is mainly mixed deciduous-evergreen forest, and most of the trees—mainly oak, maple, beech, and pine—would be familiar to a visitor from Ontario. The major differences, of course, are the mountains and volcanoes in Hokkaido.

Within these similar environments, indigenous peoples in both areas had much in common, beginning about 10,000 years ago when the last Ice Age was coming to an end in Ontario. Hokkaido was not covered entirely by ice, permitting a small resident population to

survive there. Hunter-gatherers eventually emerged from the freezing temperatures in Japan, while across the ocean they moved into Ontario from the south, quickly adapting to the warming environment.

In Japan, post-glacial cultures are grouped broadly under the term "Jomon" until about 400 BC in the south and AD 500 in Hokkaido. Jomon people lived in pit-house villages and hunted, fished, and collected plants and shellfish. At roughly the same time, the Archaic peoples and their early Woodland descendants lived in eastern North America, including Ontario. They also hunted, fished, and collected plant foods.

As the land warmed, in both regions animals and plants that had been unseen for generations began to reappear, requiring the people to find new techniques for hunting, collecting, and preparation. Both cultures quickly developed additional tools forged of stone, wood, or bone. They also developed new woodworking tools, such as adzes made by grinding and polishing, and implements to help clear the newly forested land.

At this time in both Japan and Ontario, beautiful leaf-shaped spear points made in a variety of styles came into use. Not only did they provide for more effective hunting—fishing and deer hunting became important—but style choices also gave their makers the opportunity to express themselves in a way never seen before. As communities grew, so did the anonymity that comes with living in large groups, and style choices helped to communicate both group and individual identity in an increasingly complicated world.

As forests spread northward and local resources increased, both societies quickly learned how to use the rich variety of plants and animals colonizing the warming land. Where there had been at best a few conifers and grasses, now there were new nuts, berries, and other plants useful for food, medicine, and technology.

The growing population of Jomon—with their houses and villages—began to disturb the natural vegetation, creating the conditions for new plant communities to grow—plants such as raspberry, elderberry, sumac, knotweed, grasses, and goosefoot. Around Archaic communities in Ontario the same plants appeared.

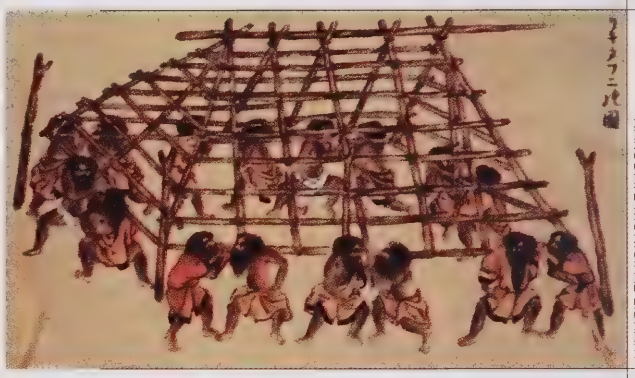
Nut trees, always far more productive along forest edges and clearings, where sunlight is abundant, came to provide a significant part of each culture's diet. If Archaic or early Woodland peoples from Ontario had been invited to a Jomon dinner, they would not have found the food very strange—there were many similar plant foods and plenty of salmon and deer, smoked and dried during the long winters, fresh in summers.

As for differences, the Jomon's rapid building of villages and production of pottery marked a divergence in essential ways from their contemporaries in southern Ontario. By 6000 BC, hamlets of pit houses in Hokkaido point to a more settled life than that lived by people of the region during the preceding Upper Palaeolithic period. Some of Japan's largest prehistoric communities existed in the northeast by 3000–2000 BC. By contrast, Ontario's Archaic and early Woodland sites were small and ephemeral, probably used only as short-term seasonal camps.

The heavily populated Jomon sites posed a practical problem for my sampling work. One site contained nearly 100 houses. After getting over the shock of the task awaiting me, I worked until the first snowfall to collect the thousands of litres of soil samples needed to determine what was representative of the site. The smaller Ontario sites posed a different problem. Fireplaces and hut floors, the best areas for collecting samples, are often hard to find.

GARY CRAWFORD

SUSUMU TAMEOKA, HISTORICAL MUSEUM OF HOKKAIDO. COURTESY MS. MICHI KITAO



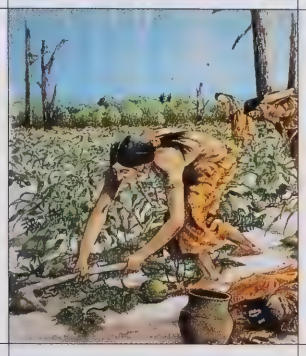
SUSUMU TAMEOKA, HISTORICAL MUSEUM OF HOKKAIDO. COURTESY HAKODATE MUNICIPAL LIBRARY

Top left: A modern-day Ainu woman with tattooed lips. Top right: This 1843 copy by Teiki Kojima is after Hakyo Kakizaki's work *Portraits of Ezo Chieftans*. (Y. and M. Kitao Collection). Bottom: The process of building an Ainu house is illustrated in this work, one of a series by Shimanojo Murakami from *Illustrations of Ainu Livelihood*.

Jomon people were renowned for their cord-marked pottery—decorated with impressions of string on the clay—fired on the open hearth. They were almost preoccupied with its manufacture. The more settled they became, the more pottery they made. On one enormous site named Kamegaoka—meaning pottery hill—local residents over the last century have found large amounts of pottery just eroding out of the earth. The earliest pottery to emerge not

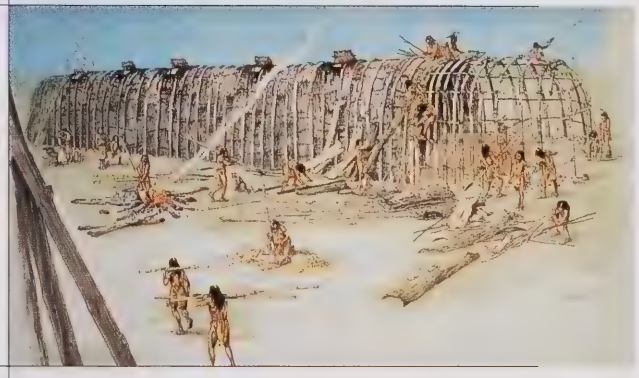
only in Japan but anywhere in the world came from northern Japan, even before the Jomon culture, and dates back nearly 14,000 years. In Ontario, the same technology was not seen until about 1000 BC, at the end of the Archaic and the beginning of the Woodland period. (Curiously, when pottery did emerge in Ontario it, too, was cord-marked.)

No doubt pottery would have affected the way these peoples prepared food. The Jomon and Woodland peoples probably ate plenty of stews made in their clay pots, while Archaic recipes, prepared without the advantage of such cookware, would have favoured food roasted on open fires or baked in pit ovens lined with stones. The Jomon also relied more heavily on shellfish, which was never significant for Ontario's Archaic and early Woodland people. At break time on one of my first days in the field in Hokkaido, I was delighted to see one of the crew sharing from his basket of fresh, whole crabs—although I still can't bring myself to suck back the green-brown innards as the local crew were doing that day.



BRIAN BOYLE, ROM

EDWARD UFNIAK



BRIAN BOYLE, ROM

Top left: After corn was brought to Ontario it became the main staple of the Iroquoian diet. Ivan Kocsis has depicted the harvest. Top right: Today's Iroquoians: The late Chief Jacob Thomas, elder of Cayuga Nation, Snipe Clan, shown in the early '90s. Bottom: Iroquoian longhouses, like the one depicted in this illustration by Ivan Kocsis, were built with saplings and bark shingles.

Although they were not committed to agriculture, the Jomon did grow some crops. Between 3000 and 1000 BC, they grew one or two types of millet, buckwheat, bottle gourd, and possibly even rice. As far as we know, Ontario's Archaic and early Woodland people did not grow crops, although it may just be a matter of time before archaeologists uncover evidence to the contrary.

Before the 1960s, secondary sources such as agricultural tools, elaborate material culture, and evidence that large communities existed were the only means for archaeologists to determine, sometimes wrongly, whether cultivation was taking place and what food items comprised local diets. They also thought it safe to assume that residents of early sites with no elaborate material culture did not have domestic plants or animals. But by the 1960s, researchers were using a new technique called flotation to find small traces of plant remains, particularly seeds and fruit, that would otherwise go unnoticed at excavation sites. In this method, soil is simply taken from a hearth or other food-preparation area and placed in water. Plant material—such as burned grains—floats to the surface, indicating exactly what was being grown and used. Today, these traces can be directly radiocarbon dated to determine their age.

Archaeologists were in for a lot of surprises once flotation became a normal part of their field methods. And I've had my share. Over the years in northern Japan we have found rice, millet, buckwheat, and other grains in prehistoric contexts where most archaeologists would never have expected their discovery. I'm not so easily surprised any more.

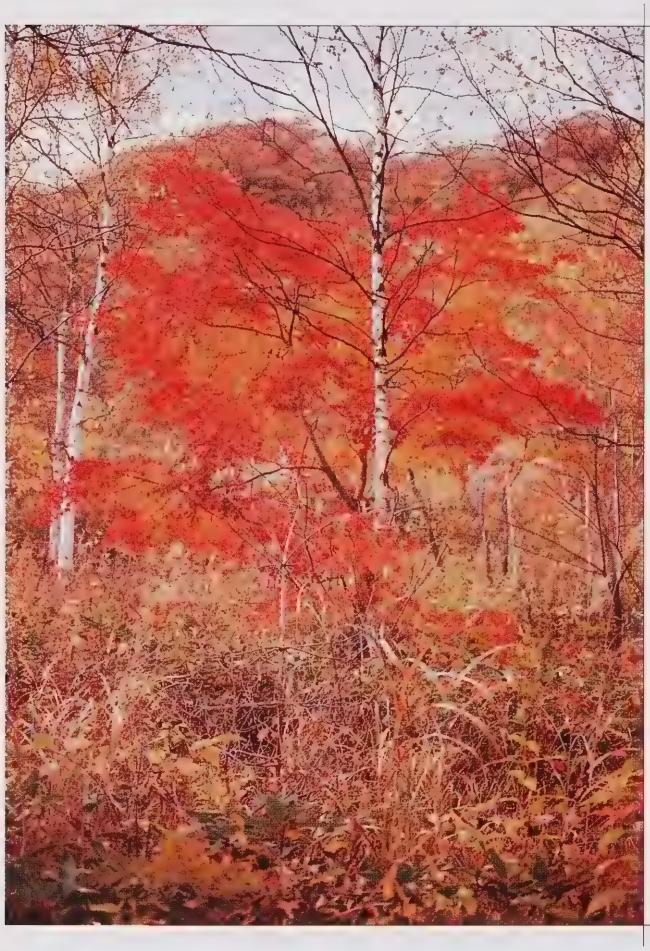
Wherever Jomon and Archaic cultivation of crops began, the commitment to them was minimal—agriculture had no substantial impact on their lifestyles, which were already rich from hunting and gathering. This key discovery tells us that agricultural beginnings are not rooted in marginal, resource-poor areas as was previously believed. For many years, archaeologists thought that agriculture developed to provide extra food where it was otherwise difficult to obtain. It was also assumed that when crops evolved, people quickly came to rely on them at the expense of other resources. We now know that the introduction and development of crops did not necessarily transform people precipitously into farmers.

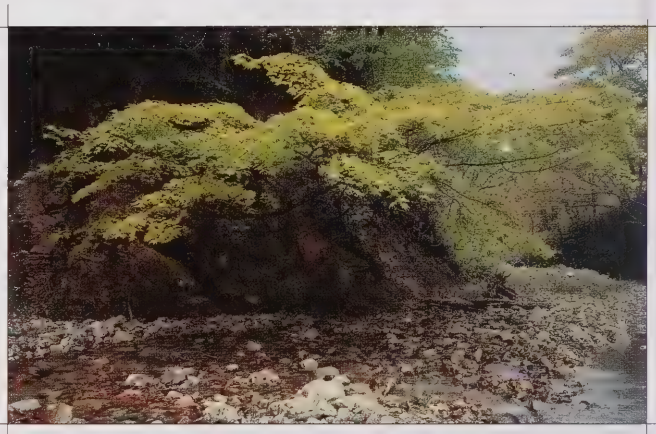
Initially, agriculture would have provided dietary variety and a wider range of storable food to help compensate for seasonal fluctuations. Growing a few crops permitted people to maintain a hunting and gathering way of life with a little extra security. In Japan and eastern Ontario, agriculture did not make a significant impact until staple crops such as corn appeared suddenly from outside their range, indicating that they were introduced.

By 1000 BC, the archaeological records of Japan and northeastern North America start to converge. In northern Japan, people were building stone and earthen circles that demarcated cemeteries. They were attaching great significance to ancestral lands and building tangible symbols on the landscape for future generations to see. Some

burials in these cemeteries have apparent symbols of authority, such as polished and carved stone batons. Millet-based food production was developing, although traces of rice are also known. In Ontario, the Serpent Mounds site on the shore of Rice Lake and the LeVesconte Mound on the Trent River indicate that the people here participated in similar cultural rituals surrounding death.

northern Japan. We know this because pottery styles, exemplified by exquisite works from the Kamegaoka and Korekawa sites, become remarkably elaborate and uniform across most of northeastern Japan. The area has been termed the Kamegaoka Interaction Sphere by some archaeologists. During the Final Jomon, the pottery takes two forms: a utilitarian, plain ware and a refined, highly decorative type perhaps used for ceremonies and/or exchange.





Flora in eastern Ontario is remarkably similar to that of northern Japan. Left: A maple tree in Kakkumi Park, Minamikayabe, Japan. Top right: A river scene in Hokkaido, Japan. Bottom right: Chinese lantern plants growing in Japan.

From about 500 BC to AD 400, Ontario's peoples were linked to those of the midwestern U.S. in a larger cultural system that archaeologists call the Hopewell Interaction Sphere. So far, no evidence has been found to indicate that crops were being raised in Ontario during this time period, but traces of corn have been found in the Illinois Valley and in Tennessee, where maygrass (a crop similar to millet), sunflower, and a few other plants were grown. Interestingly, new types of status-related items also began to appear in Ontario at the time of these exchanges, including copper pan pipes and effigies cut from mica. The exchange or trade mechanisms likely involved far more complex sociopolitical structures than had previously existed.

During the Late and Final Jomon, 1200–100 BC, similar social interactions spread to connect most of

The existence of a culture with two sets of pottery at this time is not known outside Japan. The significance of this hit home to me only after I visited the Korekawa Site Museum during the only hail storm I've ever witnessed in my many years working in Japan. The storage shelves in the museum are lined with plain pottery I don't recall seeing in publications or display cases, probably because it is so ordinary. But its existence alongside the highly refined pottery suggests that distinct hierarchical social systems may have developed by this time.

By 100 BC, the culture called Final Jomon had come to an end. The following Jomon culture called the Epi-Jomon continued in Hokkaido until about AD 500 or

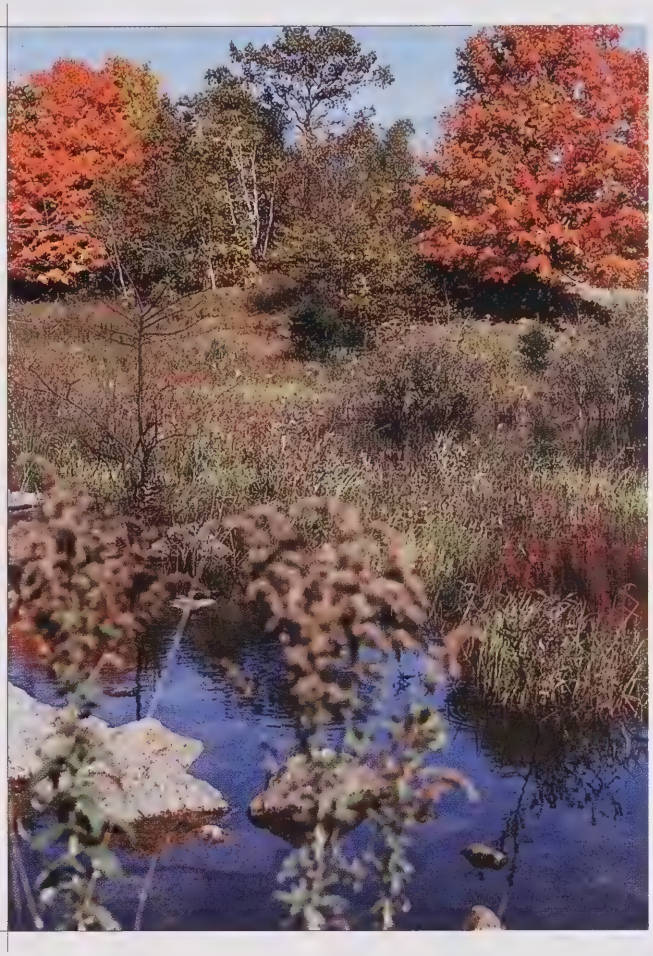
600. It did not have the socioeconomic complexity of the preceding Late and Final Jomon. The Epi-Jomon was more mobile and egalitarian than its predecessors. Epi-Jomon sites are smaller and less elaborate. In fact, few pit houses have been found from this culture. Occupations seem to have been seasonal. The Epi-Jomon sites I have worked on are a mix of burial pits, post holes, and hearths built on the ground surface. Pottery is not nearly as elaborate as that from the preceding period. The regional interconnections are less pronounced. We have found a few crops at Epi-Jomon sites but nothing to indicate that the people were committed to agriculture. If a power structure was in place, archaeologists will have a difficult time recognizing it.

In North America, around AD 400 the Hopewell Interaction Sphere also comes to an end. Although a few centuries later than the end of the Final Jomon, the comparison with northern Japan is still striking. A variety of later Woodland groups, who, like the Epi-Jomon, were much more egalitarian and locally oriented than their predecessors, appeared across much of the northeastern Woodlands.

Why should the Kamegaoka and Hopewell interaction spheres come to be replaced by less complex cultures? It may be inaccurate to say the cultures "ended," but profound changes had taken place. Archaeologists are still trying to work out what actually happened at this time, and one possibility is that the more local focus of the Kamegaoka and Hopewell descendants might be linked in some way to the local autonomy brought about by the new and more productive crops.

Just as corn agriculture was encroaching on Ontario from the south, a complex of crops was moving to Hokkaido from the south of Japan. Yayoi migrants arriving in southern Japan from Korea around 400 BC brought with them intensive agriculture, with millet, wheat, barley, and rice crops. Within a few short centuries the Yayoi replaced or transformed most of the Jomon culture on Honshu—the main island south of Hokkaido. By AD 300, all of Japan south of Hokkaido was agricultural, and the aspiring future emperors were already consolidating power in the Kyoto area.

In northernmost Honshu, the culture known as the Tohoku Yayoi blended local Jomon and Yayoi character-



Top left: The East Humber River at the Seed-Barker site in Ontario. Bottom left: The trillium, provincial flower of Ontario, also grows in Hokkaido, Japan. Right: An autumn scene near Gould Lake, Ontario.

istics. Its descendants were the Satsumon, whose culture began after about AD 600. People lived in pit houses that usually had an oven and chimney built into one wall, much like houses elsewhere in Japan at the time. The pottery they made resembled the wares of their contemporaries to the southwest, who were already participating in the developing nation state of Japan.

But pressure from the south, including warfare, forced the Satsumon to abandon Honshu and flee to Hokkaido. The Satsumon newcomers occupied nearly all of Hokkaido by AD 1000, replacing the Epi-Jomon. There they were isolated; Hokkaido would not become part of the Japanese nation state until 1868.

The Satsumon brought wheat, barley, several millets, beans, and other crops with them to Hokkaido. The distinctive cord-marking of Jomon pottery was replaced by Satsumon—which is decorated with impressions of wood and leaves and sometimes incised with lines and geometric shapes. By AD 1200 pottery and other utensils could be obtained through trade with the Japanese in Honshu, and local manufacturing ceased altogether. This marks the beginning of the Ainu period, which was contemporaneous with the Iroquoian nations in Ontario. Ainu culture flourished in Hokkaido until the late 1800s and, though less visibly, still exists today.

Remarkably, events in Ontario follow a similar path, although we don't understand as much about the Ontario situation because the research is not as far along. About 10 years ago I started to feel extremely uncomfortable that we knew so little about such an important period in Ontario—my own backyard. I recall remarking to a colleague, David Smith, that somebody ought to be looking into it. In 1993, David and I decided it was up to us, and we have been investigating the problem ever since.

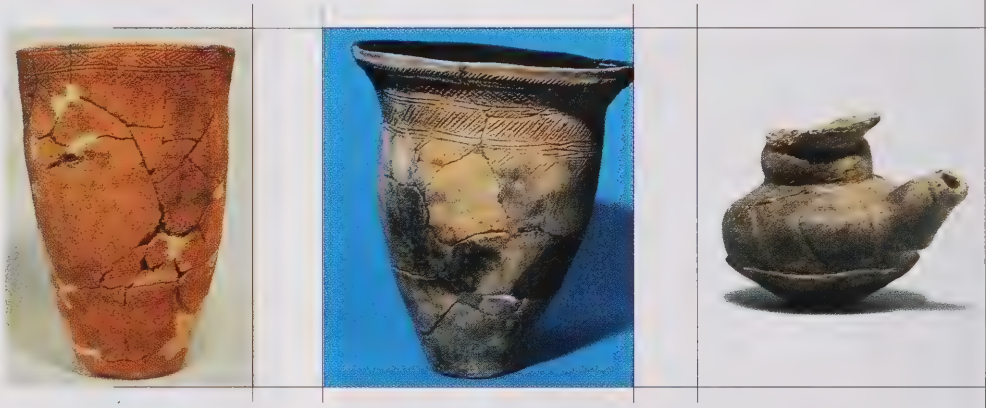
The main Iroquoian crop, corn, originated in Mexico and was introduced indirectly by a combination of down-the-line exchange and possible migrations. Gradually, the grain made its way to Ontario, where the oldest existing fragments of charred corn have been radiocarbon dated to AD 500–600.

The first people to grow corn in Ontario belonged to the Princess Point culture (AD 500–1050). These people are believed to be ancestral to the Huron, Petun, and Neutral Iroquoian cultures of Ontario. Just as the Satsumon moved to Hokkaido, the Princess Point may have moved to Ontario, but the evidence for a migration is not as clear as it is for the Satsumon migration. Still, as in Hokkaido, people became committed to agriculture sometime around AD 700–1000.

And, remarkably, as it was in Hokkaido, the cord-marked pottery of the earlier Woodland and Princess Point people was replaced by incised pottery made by the Iroquoians, though at a later date, AD 1100–1200. Longhouse villages—considered a hallmark of Iroquoian culture—became the norm after AD 1200, the very time that marks the beginning of the Ainu period in Hokkaido.

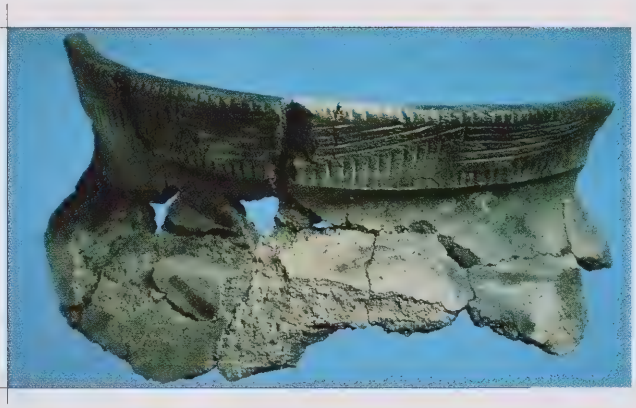
Why the timing of these events in Hokkaido and Ontario is so similar is puzzling. Archaeologists are tempted to look for an explanation in some worldwide event, such as climate change. But even that wouldn't explain the similarities—people of different cultures don't necessarily respond in the same ways to similar events.

Finally, many parallels exist between the Ainu and the Iroquoian peoples who succeeded from the earlier cultures. In Hokkaido, the Ainu supported themselves



Top: Completely excavated pit house at the Yagi site in Hokkaido dates to the early Jomon; Bottom left: Early Jomon pot from Hamanasuno site, c. 3500 BC, shows cord-marking; Middle: Satsumon pottery like this example dating to c. 800 AD has no cord-marking but incised lines; Right: This teapot form pottery from Late / Final Jomon is not cord-marked, as was common with fine wares.

with a mixed economy based on hunting, fishing, gathering, and raising crops, as did the Iroquoian people of Ontario. Though this wasn't unusual in the world at the time, the crops grown were surprisingly similar: they included grasses (corn in Ontario, wheat, barley, and millets in Hokkaido), beans, squashes, and items from the aster family.



Top: The posts in the foreground at this excavation site at Crawford Lake, Ontario, were erected in the post holes of the original longhouse; Bottom left: Huron pot with incising along rim dates to early 1600s; Bottom right: Iroquoin pot dating to 1500s shows incised design.

Religious systems of both the Ainu and Iroquois were animistic—involving shamans and a rich variety of deities to guide and influence peoples' lives. The bear ceremony was an important Ainu ritual in which a fully grown bear, raised from a cub, was sacrificed to release its spirit and thus provide for the Ainu. Bears were also important spiritually to the Iroquois—and for that matter to peoples all across the world's temperate regions, dating as far back as the Neanderthals. I once asked Shigeru Kayano, an Ainu elder, about the sacred arrows that were used during the bear ceremony. He told me that the shafts were made of wormwood, considered the most powerful plant, not for its useful strength or straightness for hunting, but because it is the first to grow back when land is cleared. The Ainu sense that plants have innate power has stayed with me ever since.

Both the Ainu and the Iroquoian societies were egalitarian, with relatively informal political organization compared to the politically centralized and complex, non-egalitarian state form of the Japanese and European societies with which they ultimately, and with limited success, tried to coexist.

Iroquoian peoples generally stopped making pottery and stone tools shortly after European contact. The availability of European pots, pans, and tools made of metal had a great deal to do with this, just as Ainu and Japanese contact brought about changes in material culture in Hokkaido. Ainu dominance of Hokkaido ended with the island's colonization by Japanese from the south. The Ainu had maintained their independence for centuries in the face of Japanese and Russian attempts to control Hokkaido. These outside players were trying to control the fur trade and access to other resources—as were the French and English in northeastern North America. The Ainu lost control of Hokkaido under the relentless pressure from the developing Japanese nation state. Warfare, death, disease, and slavery all were part of the story. So recent are these events that Shigeru Kayano recalls that his grandfather was forced into labour as a child.

Today, Ainu people are more or less integrated into Japanese society, but a number of communities maintain their Ainu cultural integrity. The similarity to the diminished Iroquoian presence in Ontario is striking, although the Iroquoians have a much greater stature in Ontario than do the Ainu in Hokkaido.

The archaeology that has engaged me for more than two decades on both sides of the Pacific has been much more than research on sites and cultures. It continues to be the study of two peoples who—despite having no direct connection—have similar pasts. Why this is so is a question for the future. Archaeology as a science is not simply about finding answers—it must also find the right questions. My comparative work in Hokkaido and Ontario is part of the search for questions. For now, the parallels between the unique histories of these two areas provide a framework to understand how northern agricultural societies developed, and how they were able to survive in the face of a rapidly changing modern world.

On the Road to

In Guyana, the teeming rainforest of Iwo
Luckily the country has devised an unprecedented sc

By Burton Lim and Mark Engstrom

Conservation

ma supports an astonishing array of mammals.
e for their well-being—and its own.

When Zacharias Norman arrived at the Iwokrama Forest of central Guyana one night in 1997, he could hardly believe what the dim beam of his flashlight revealed. Rendered oblivious to the stifling heat and constant biting of mosquitoes, he stood calf-deep in a tropical rainforest stream, mesmerized, as we untangled 11 species of bats that had been caught that night in our nets.

Like many people, Zach, a Guyanese forest ranger working in Iwokrama Reserve, had always thought that when you've seen one bat you've seen them all. He was

BURTON LIM, ROM

BURTON LIM, ROM

Previous page: Vehicles loading at the Essequibo River ferry crossing, with Martin's Island in the background. Above: A stilt-rooted tree provides shelter for mice that forage on the forest floor during the night. The live box-trap hidden in the foreground was used during a survey of small mammal species.

amazed to learn that our research team from the ROM's Centre for Biodiversity and Conservation Biology has documented 86 bat species virtually in his own backyard. The bat diversity in Iwokrama is the highest recorded anywhere in the world.

Much of this information was gathered in 1997, when the team took two intensive six-week field trips to a number of satellite camps in differing habitats in the Iwokrama Forest, ranging from swamp forest to rocky mountains. Our main goals were to document how many mammals occur in the country, where the different species of bats and other mammals are found and in what numbers.

One camp on the Burro-Burro River near the reserve's northern boundary was particularly productive for bats. The usual method for bat catching is to stretch a 12-metre- (39-foot-) long mesh net over a natural flyway such as a stream. This works well for capturing bats that fly in the forest understorey—for example, fruit-eating bats or insect gleaners that listen for sounds from potential prey before swooping down for the kill. But it misses a whole group of bats that fly high in the canopy, catching insects on the wing.

We out-manoeuvre them by hoisting an enormous 10 x 30 metre (32 x 98 foot) net up into the canopy, not an easy thing to do. This new technique has contributed in part to our recent addition of 24 species to the list of bats known in Guyana.

These findings are just some of the many to have come out of a bold experiment being conducted in Iwokrama Reserve's 3600 square kilometres (1440 square miles) of pristine lowland forest. The experiment was conceived in 1989 when Guyana made the unprecedented move of offering management of a section of its country—the part now known as Iwokrama Forest—to the British Commonwealth Secretariat, under whose auspices it is governed today. An autonomous body, Iwokrama International Centre for Rain Forest Conservation and Development, was formed to steward the land. Its mandate is to make Iwokrama economically viable while maintaining its environmental integrity. Today, sustainable uses—such as ecotourism and the development of non-timber forest products—take place under the same canopy as a vigorous

conservation program.

Long before any of this came to pass, in 1961, ROM curator Dr. Randolph Peterson had already decided that Guyana would be an excellent site to study mammals. He conducted mammal research there until 1976, and continued to compile and write about his findings until his death in 1989 (see "Dr. Peterson's Legacy," at right). On the strength of the ROM's history in Guyana, several organizations have invited the ROM to collaborate in various conservation and monitoring programs in Iwokrama Forest.

Since 1990, the ROM has been part of an international team of researchers that is documenting the biodiversity of Iwokrama and other parts of Guyana and training rangers like Zach in scientific documentation and conservation methods. We have also been able to continue Dr. Peterson's ambitious project to discover and study the mammals of Guyana.

The success of the Iwokrama programs and initiatives may be instrumental in securing a more prosperous future for Guyana as the country strives to break free from the ranks of under-developed nations. Unfortunately, outsiders sometimes associate Guyana with such tragedies as the Jonestown massacre and the Omai Mines cyanide leak, or with having one of the highest ratios of debt per capita in the world.

Instead, the government hopes to create a vibrant economy that will elevate the country to economic self-sufficiency, which would in turn help stem the flow of emigration.

Ironically, being one of the poorest nations in South America has actually spared Guyana from most of the environmental woes of many of its tropical neighbours. Guyana's lack of infrastructure means that most of the nation's 800,000 residents are concentrated along the coastal highway that skirts the Atlantic Ocean, leaving the vast majority of the country's richly biodiverse terrain relatively untouched.

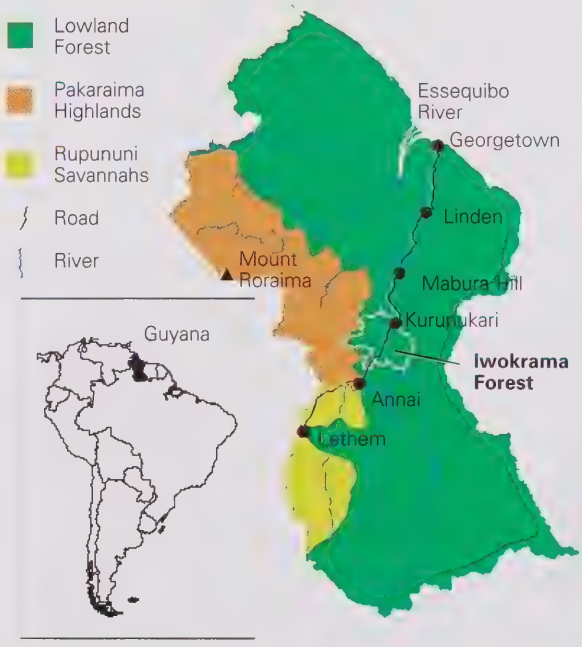
Derived from an Amerindian word meaning "land of many waters," Guyana—which gained independence in 1966 and has been a republic within the Commonwealth since 1970—has a decidedly Caribbean flavour. It is the only country in South America whose first language is English—

ROM ARCHIVES

Dr. Peterson's Legacy

Guyana first lured Dr. Randolph L. Peterson, the late ROM curator emeritus of mammals, to its shores in 1961. The foremost authority on North American moose and author of the seminal book *Mammals of Eastern Canada*, "Pete" was spurred by an initiative at the ROM to broaden its research scope and explore beyond Canada, particularly in Commonwealth countries. He chose Guyana. There he discovered a new species of bat and solved several biological puzzles, including the discovery of extreme sexual dimorphism (females much larger than the males) in what is now considered one species of white-shouldered bats. Little did he suspect at the time that his research project on bats would run for 28 years, becoming one of the world's longest in-depth studies of mammal diversity in the tropics. After his death in 1989, we had the honour and pleasure of working to complete his life's work. One of the many legacies Pete left to the ROM was the remarkable bat collection he had amassed over 28 years of work in Guyana and other locations around the globe, arguably the most comprehensive contemporary collection in the world.

—B.L. and M.E.



From top to bottom: The cast iron structure of Stabroek Market in the heart of Georgetown; A fully loaded Bedford truck takes a break at the Iwokrama field station; One of the smaller flat-topped tepuis, Mount Ayangaik, is visible along the Mazaruni River; Iwokrama forest ranger Zacharias Norman admires a greater spear-nosed bat (*Phyllostomus hastatus*).

BURTON LIM, ROM

and its citizens love cricket with a passion. What the country lacks in financial riches, it easily makes up for in natural beauty, as ROM biologists discovered in 1990 on the Museum's first trip there since Peterson's time. It was one year after Iwokrama was offered to the Commonwealth.

The ROM had been invited by Youth Challenge International (YCI)—a Canadian organization that works on community, health, and environmental projects in tropical countries—to lead biological surveys in advance of a road's construction through the forest. Though the legal establishment of Iwokrama—including a statement of the official objectives, functions, and organization of the forest's management—was still years away, the Guyanese government had a prior commitment to connect with the Trans-Amazonian road system under construction in Brazil. They were forging ahead with a new bush road that now cuts a swath through the heart of the 30-metre- (98-foot-) tall Iwokrama rainforest. The road serves as the main link connecting existing roads in the inhabited north coast with the "wild west" of the Rupununi savannahs, which lie southwest of Iwokrama along the frontier with Amazonian Brazil. Our job was to compile an inventory of wildlife species present in the forest prior to development. The data will be used to help track the health of the forest in years to come.

Our team of biologists set off from the capital city of Georgetown at the mouth of the Demerara River—the name commonly associated with the brown sugar that is produced there—to the bauxite-mining town of Linden, 100 km (62 miles) to the south. We continued 150 km (93 miles) to the village of Kurupukari on the Essequibo River, the main entry point into present-day Iwokrama Forest. Our route followed a nearly untraversable network of logging roads that often degraded into mud wallows, and even turned into lakes in the rainy season.

We jounced along the existing "road" toward the forest, our heads hitting the steel-reinforced canvas roof of the hired Bedford truck—famous for its service in the British Army. It seemed to be the only vehicle up to the job of plying the "world's worst road," as it was dubbed by a Japanese documentary film crew that shortly afterwards traced the same path.

Beyond Kurupukari, we entered Iwokrama Forest itself, following the route of an old cattle trail that had fallen into disuse after the collapse of Guyana's beef industry in 1969. The trail was so overgrown that it could barely be distinguished from the forest proper. It is debatable which is more painful—hitting the truck's roof with your head or slamming back down on the wooden crates that served as seats. We arrived at our destination two days later, caked in red laterite soil and deprived of sleep.

Still, the rough trip was well worth those first glimpses of Iwokrama's unspoiled splendour. Entering a tropical rainforest was a surreal experience—we were engulfed by huge, buttressed trees towering overhead and enveloped by the constant, unfamiliar droning sounds of the wildlife.

The forest is named after Iwokrama Mountain, which at almost a kilometre (half a mile) high is the predominant topographic feature in the area. Iwokrama Forest forms part of the amorphous teeming jungle on the north coast of South America that 16th-century explorer Sir Walter Raleigh thought might hold the mythical golden city of El Dorado. Alas, he found no gold-paved streets, but as we began our biological survey we did unearth a wealth of fauna. Our team seined for fish near the banks of the mighty Essequibo River, plumbed the depths of the Guyanese soil for invertebrate animals, collected a myriad of insects, deftly captured snakes and frogs, and relentlessly stalked bats and rats. These initial collections formed a basis for the biological inventory work that would follow.

By May 1996, six years after that first visit, Guyana and the Commonwealth had finally mapped the boundaries of Iwokrama Forest. The president of Guyana formally assented to the Iwokrama Bill and a field station was constructed. The United Nations Development Program provided seed money for official operations to begin, and the Commonwealth Secretariat and International Development Research Centre of Canada made further contributions to the project.

ROM researchers have since returned to Iwokrama and other parts of Guyana numerous times. To date, ROM biologists have documented 225 mammal species in the country. Based on data from neighbouring

Suriname and Venezuela, we estimate that a further 24 are likely to inhabit Guyana but have so far remained undetected. Just over half of the recorded species (121) are bats. The second most diverse group is rodents, at 42 species. Apart from these two, no other order of mammals accounts for more than 10 percent of the total diversity. By comparison, Ontario, which is more than five times the size of Guyana, hosts only 86 mammal species. Only nine kinds of bats live in Ontario, fewer than the number we caught that first night Zach came into camp—and that was an off night for netting.

Typical of lowland Amazonian rainforest, the vegetation of Guyana is much the same throughout the country, with 80 percent of the land covered by forest and 99 percent of the topography below 1000 metres (3300 feet). Because of this, much of the mammal fauna is probably evenly distributed throughout the country, although some species do have restricted ranges.

One exception is the staggering contrast between the lush boundary of Iwokrama Forest and the Rupununi savannah just a few kilometres away. The savannah, which sprawls from southwestern Guyana into neighbouring Brazil, is always hot. The only cooling shade is from gallery forest bordering the rivers and streams that meander across the flat grasslands. And the Rupununi is often dry. When it does rain in the savannah lands, it pours. Over four metres, four times the typical annual rainfall in Ontario, has been known to fall in a continuous onslaught in just a few months. This is more than enough to swamp even the usually reliable Bedford army truck. Cruelly, these deluges are interspersed by years when only 140 mm (5 ½ inches) of rain falls, barely a dribble.

Despite the savannah's climatic roller coaster ride, many different mammals inhabit the area and several species are found only there, including an opossum, three species of rodents, a bat, and a fox. There is also a unique subspecies of the same white-tailed deer that is found in Ontario.

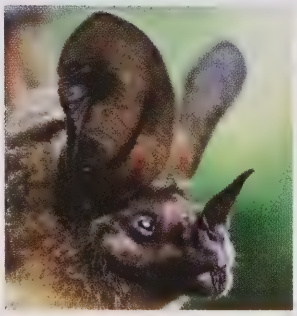
To the north of the savannah, spreading westward into Venezuela, is another exception to the prevailing geography—the sandstone-and-quartzite-based Pakaraima Highlands, which rise approximately 500 metres (1640 feet) above the surrounding

Blackboards in the Jungle

Local interest and involvement are crucial to the success of any conservation effort. Yet in tropical countries people often do not fully realize the wealth of biodiversity that surrounds them, partly because of the paucity of educational materials. Nowhere is this more true than in Guyana. When Zacharias Norman, a Guyanese forest ranger, learned that at least 86 species of bats live in Iwokrama, he became keenly interested in their biology and in preserving their habitats. As part of our work in Guyana, ROM biologists have developed and delivered educational programs (such as ranger training courses) and worked with local staff to produce field guides that can be used to observe and identify mammals.

Together with the North Rupununi Development Board and the Iwokrama International Centre for Rain Forest Conservation and Development, we have developed and written an illustrated guide to the mammals in Iwokrama that is available both on the World Wide Web and as a pocket-sized publication. These booklets are being distributed throughout local communities and to ecotourists in and near Iwokrama. The goal is not only to heighten people's awareness of mammals in the area but also to ask for their individual help with conservation by recording information about mammals they have seen in the reserve. The information will be used to update the database of distributional records and to monitor changes in the fauna as portions of the forest are developed. Thus local people and tourists will participate directly in conserving their own biological resources—an effort that cannot succeed without their cooperation.

To view or download the on-line guide to the mammals of Iwokrama, visit: http://www.sdnp.org.gy/iwokrama/Wildlife/ROM/mammals/index.html. For a checklist of mammals of Guyana, visit: http://www.mnh.si.edu/biodiversity/bdg/guymammals.html



MARK ENGSTROM, ROM

Tonatia silvicola (pale-throated round-eared bat) has large ears used to listen for sounds of potential insect prey.

land, as high as a 130-storey skyscraper. This plateau is dotted with flat-topped mountains called *tepuis*, or mesas, whose sheer-faced cliffs soar from the surrounding mix of savannah and forest to nearly 3000 metres (9840 feet). The most famous of them, Mount Roraima, inspired the classic adventure novel *The Lost World* by Sir Arthur Conan Doyle, author of the famed Sherlock Holmes series. In the book, the top of this isolated refugium hosted a primitive human tribe at war with ape-like creatures while dinosaurs roamed in the background! In reality, of course, no such life forms exist on Roraima, but the *tepuis* is home to several endemic species of organisms—such as the carnivorous sun pitcher plant, which stands over one metre (3 ¼ feet) in height, and the Roraima mouse whose elongated front claws are thought to be used for digging—that are not found anywhere else on the planet.

Perhaps 50 percent of the plants in the Guiana Highlands, the distinctive region that encompasses Guyana's Pakaraimas as well as other *tepuis* in Venezuela and Brazil, is unique to the area. The percentage of mammals endemic to the highlands region is much lower—less than 5 percent—but there are at least three mice and one marsupial that live nowhere else.

Working Together for Conservation

The collecting of basic biological data in Iwokrama Forest has been a collaborative effort between the ROM and many like-minded institutions. The Smithsonian Institution in Washington, DC, has implemented the Biological Diversity of the Guianas program, which has been operating in Guyana since 1983. It initially concentrated on making an inventory of the region's plant life but more recently has funded researchers studying animal diversity. In conjunction with the Royal Bank of Canada and the World Wildlife Fund, the Smithsonian was able to establish the Centre for the Study of Biological Diversity on the campus of the University of Guyana. The Centre is to function not only as a museum and herbarium for specimens but also as a resource centre for work on biodiversity. Part of the ROM's collection of mammals from Guyana is already housed there.

The Netherlands-based Tropenbos Foundation, another prominent organization working in Guyana, is involved in the conservation and sustainable use of forests. Its study site off one of the logging roads south of Mabura Hill provides an interesting comparison with Iwokrama, which lies about 100 kilometres (62 miles) to the southwest. Tropenbos researchers have been very active in publishing the results of their studies on applied forestry and in training Guyanese graduate students.

The Academy of Natural Sciences in Philadelphia was awarded the contract by Guyana's Ministry of Foreign Affairs to conduct faunal surveys in Iwokrama Forest. The University of Kansas, contracted to do the mammal work, knew of the ROM's long-time involvement in Guyana and asked us to collaborate on the project, which we gladly accepted. This project has resulted in one of the most in-depth surveys of mammal diversity in South America and has demonstrated that the mammal fauna comprises many more species than previously thought.

The year after our first bone-jolting trip, the road to Iwokrama was completed. Since then, astute locals have quickly taken advantage of the opportunities offered by this newly opened hinterland. An unexpected benefit of our trip was meeting some of Guyana's colourful characters along the road to conservation. Businessman Eddie Singh bought a fleet of Bedford trucks to haul people's supplies into the interior at a fraction of the cost of flying them in—previously the only option. His service also doubles as a bus line that provides cheap passage (although passengers are sometimes required to ride on the roof) between Georgetown and the far-flung Amerindian villages scattered throughout the southwest.

On one trip we were entertained by the banter of "Doc" Depu, a haberdasher feeling out new markets, selling wares along the road from the back of Singh's truck. At sunrise on the second day of our journey, Doc provided a detailed personal profile of each passenger based solely on the previous night's conversation, which had been conducted in total darkness, with only the voices of strangers rising above the noise of the Bedford careening down the trail.

When we reached the Essequibo River near Kurupukari, we met Martin, a former member of the road-building crew. He has set up shop on an island in the middle of the river and has travellers at his mercy—a side trip to Martin's is the only respite from the sometimes lengthy wait for the irregular ferry and truck services. Aahh, but to interrupt your hot, bumpy journey with a cool beer from the propane-powered fridge is worth any delay. Almost anything

can be purchased on Martin's Island. And few stories go untold.

One memorable evening, lubricated by the mix of local Bank's beer and Demerara cane rum, a ROM crew was regaled with tales of Guyana's rugged past and of Eddie, Doc, and Martin's bright hopes for the country's future. In the 1960s, Eddie was the first to "drive" from Georgetown to Lethem, years before the Iwokrama road link was ever contemplated. Piloting a land-cruiser through virgin rainforest wasn't his biggest challenge—it was floating the vehicle on a wooden raft across the Essequibo River. His adventures make our journey seem tame.

While the new road has given us a few good stories, its impact on the surrounding, previously isolated, Amerindian communities and the unique rainforest-savannah ecosystem has yet to be determined. Continuing to collect basic biological data will help in determining that impact. With solid data to draw from, the Guyanese government and the Commonwealth will also be much better able to make informed decisions about conservation priorities and to allocate funding accordingly.

We have reached a point in our work where we can now make informed predictions on actual geographic ranges of mammals, pinpoint areas of high biodiversity, and indicate regions of high priority for conservation. Although we have made great strides over the past 10 years in documenting the biodiversity of Guyana, there is still a lot of basic biological information yet to be discovered—the number of species, their abundance, and their distribution.

But just as vital a legacy lies in passing along our knowledge and skills. Part of the ROM's work in Guyana is building a reference collection that is representative of Guyana's mammal diversity. Deposited at the Centre for the Study of Biological Diversity on the campus of the University of Guyana, this national collection is used for teaching and to provide a physical historical documentation of the mammals at that particular time and place—a snapshot that will be useful for future evaluation of the extent of environmental change.

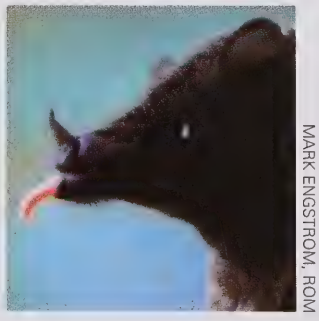
On the most recent trip to Iwokrama Forest, we ran a training course for park rangers and wildlife biologists, concentrating on field methods for conducting surveys and establishing a long-term monitoring program for mammals. Many of the rangers, including Zach, had assisted on previous trips, but this was a more formal week-long instructional session with lectures and exams on both general biology and field techniques (see "Blackboards in the Jungle," page 43).

This type of local training and the transfer of technology will be needed in Iwokrama to maintain the balance between conservation and sustainable use for economic benefit. Although we still joke with Zach about his one-bat hypothesis, he is one of the many accomplished Iwokrama forest rangers who will lead the country along the right path to conservation. ●

BURTON LIM, ROM

The Land of Six Peoples

In colonial times, the Dutch were the first to establish a trading post in Guyana in 1626 on the Essequibo River, the main route inland that bisects present-day Guyana. When visions of gold failed to materialize, the Dutch turned their attention to sugar cane, which today is still Guyana's main industry. By the time the British took firm possession of the country in 1796, a system of dams and canals was well established on the coast. Huge sugar estates sprang up in the area and their early success was built on the backs of African slaves forced to labour on the plantations. With the abolition of slavery in 1834, indentured workers were brought in primarily from India but also from Madeira, a Portuguese island colony off the coast of Africa, and from China. Together with the indigenous Amerindians and the colonizing Europeans (Dutch and English), these groups compose the ethnic make-up of Guyana today, the Land of Six Peoples.



MARK ENGSTROM, ROM

Choeroniscus minor (long-tongued whiskered bat) has an elongated snout and tongue adapted for lapping up nectar in flowers.

May we suggest some unique Christmas gift ideas?

Discover the answer to the eternal gift giving dilemma. Original gift items from the ends of the earth and from the beginnings of time. Open Monday – Thursday and Saturday from 10 am until 6 pm. Friday from 10 am until 9 pm, and Sunday 11 am to 6 pm. Members receive special discounts on December 8th, 9th and 10th.

Royal Ontario Museum • www.rom.on.ca

Historically Great Gifts

ROM
The Shops

CULTURE, ART AND DESIGN

A Science on the Move

A 17th-century Japanese desk secretary shows why art conservation must change with the times.

983.25.284

Top: The *namban* secretary seen in 1975, before conservation work, shows the poor condition of the lacquer, loss of mother of pearl, and the mouldings that were added around the edges during the Victorian era. Bottom: Shown again after treatment, the *namban* box has been restored to its original condition with the oil painting and mouldings removed and the underlying lacquer surface repaired. More than 700 pieces of lost mother-of-pearl were replaced.

BRIAN BOYLE, ROM; GILLIAN WATTS, ROM

Art conservation is an ongoing process. As objects age through decades, centuries, and even millennia, the methods used to repair and restore them improve with technological advances. A *namban* desk secretary recently chosen for display in the ROM's Herman Herzog Levy Gallery proved to be an excellent example of this process.

Constructed in the 17th century, during the Japanese Momoyama period—before Japan closed its doors to contact with the outside world—the *namban* box first arrived at the ROM in the 1960s. The word *namban*, Japanese for "foreign," denotes an article produced specifically for export. This box is considered to have been made for export to Portugal: the handiwork is undoubtedly Japanese, yet the design is clearly based on European styling. Probably constructed of Japanese cypress, the box measures 40 cm deep x 75 cm wide x 53 cm high (15½ inches x 29¼ inches x 20¾ inches). The black lacquer background shows to good advantage the gold geometric and floral designs, which are further enhanced by mother-of-pearl inlay.

When it arrived at the ROM, the box was in very poor condition even though it had already undergone some restoration work, perhaps as far back as 100 years earlier. At that time, the entire box was coated in a heavy layer of varnish. This common Victorian treatment was thought to enhance the lustre of a lacquered piece, but it created complicated challenges for future conservators. Also, a painting on canvas was affixed to the top of the box, perhaps in an attempt to obscure large losses of decoration. As well, edges of the box were framed with moulding.

The ROM's first efforts to restore the piece were performed by Gillian Moir. She documented the beginning of the project in a *Rotunda* article ("An Un-Restoration Project," Fall 1978). Moir discussed in depth the problems created by the Victorian-age restoration work, efforts she considered "insensitive," and pointed out the key challenges for the conservation team.

In 1982, Marianne Webb took over from Moir as decorative arts conservator. One of her first assignments was to complete conservation work on the *namban* box, which was wanted for the major ROM exhibition *Silk Roads · China Ships* in September 1983. With a very short deadline to meet the scheduled opening, work needed to proceed at a frantic pace. Webb assessed the damage, focusing solely on this one artifact. To restore the top of the box—

DOUGLAS CONVERSE

where Moir had removed the canvas oil painting—in time for the exhibition, more than 80 pieces of mother-of-pearl had to be cut and adhered in place each day. Webb also filled losses of lacquer on the box's surface with wax and painted the decoration with acrylics.

After the exhibition, the cabinet went back into storage until this year when it was again wanted for display. It will be part of an exhibit highlighting the career of the late Hugh Wylie, curator of Japanese Art at the ROM from 1980 to July 1999. Webb, still on staff in the Conservation Department, assessed how the box has fared after so long in storage. The repair work she performed years ago is holding up fairly well. The box must be cleaned, of course, and a few areas require attention.

The wax fills done in 1982 are coated in places with bloom. These fine white particles will be carefully cleaned off and the wax coated with additional acrylic varnish to prevent recurrence of the bloom. Where wax was used for infilling even as recently as 17 years ago, now acrylics with inert materials would be used instead. These materials are less likely to change over time and are better able to imitate the soft lustre of the original lacquer. However, in keeping with today's practice of minimum intervention, the wax will remain in place unless future problems dictate its removal. The box will be on display in the Herman Herzog Levy Gallery from November 30, 2000 to May 31, 2001.

Today's museum conservators often see past restoration methods as quaint, even destructive to the artifact in some cases. If conservation is to keep museums' art treasures beautiful through the ages, it must move forward with the times—not just as science and technology advance but as greater global communication allows conservators from around the world to compare notes and access the best and most recent information available.

Douglas Converse has a keen interest in conservation and worked with Marianne Webb on her book Lacquer: Technology and Conservation.

CULTURE, ART AND DESIGN

Pressed into Service

The Lion motif graced many Victorian pressed-glass tablewares. The challenge for collectors today is distinguishing the originals from later reproductions.

Dear ROM Answers,

Could you please tell me something about this early American or Canadian glass candy dish, which has been in our family for years. Recently I heard that it is quite valuable. I would appreciate any information that you can provide. Thank you.

D. M., Uxbridge, Ontario

D.M., UXBRIDGE, ONTARIO

BRIAN BOYLE, ROM 981.166.2

Left: D.M.'s covered dish is an original piece of lion glass. Below: The pressed glass pitcher is in the "Westward Ho!" pattern by Gillinder & Sons, produced in Philadelphia c.1879. Gift of Mrs.Hugh R. Downie.

Dear Reader,

Judging from the photograph, you own a piece of what collectors commonly call lion glass. The lion motif was one of a number of pressed-glass patterns commercially available in the late Victorian period, during the 1870s and 1880s. Pressed-glass pieces were formed by mechanically pressing molten glass into steel moulds. Parts such as handles were added when the glass was hot, and additional finishing was done after it had cooled. Some pieces had animal finials, and novelties included covered dishes shaped like hens and sometimes ducks.

Dishes and comports with covers were among the most impressive pressed-glass items. The covers provided useful protection against flies and mice. Often, though, a full range of tablewares, even the finger bowls, were produced in a single design. Ideally, an entire table could be set in a matching pattern.

Lion, according to Ruth Webb Lee's 1931 book, *Early American Pressed Glass*, was one in a series of figural patterns introduced by Gillinder & Sons of Philadelphia in the late 1870s. A German named

PETER KAELLGREN

Jacobus created the moulds for Lion and other popular Gillinder patterns such as Pioneer (more commonly known today as Westward Ho!), which features a buffalo and stag. One animal pattern called Jumbo, produced by the Canton Glass Co. of Canton, Ohio, commemorated P. T. Barnum's famous elephant. Other animal patterns included Cardinal, Frosted Stork, Owl and Possum, Parrot, and Squirrel.

Lion motifs varied: there were three-dimensional lion heads, full figure lions in relief, lion heads in profile, and lions seated and raised up like the one on top of your dish. Webb Lee lists 25 different forms of the lion pattern with some, such as those for pitchers, available in a variety of sizes. The forms include a butter dish with cover, a celery vase (which looks like a large cylindrical goblet), a champagne glass, a covered cheese dish, a cologne bottle, three sizes of compotes, a cordial glass, a cream jug, three sizes of covered dishes (yours is one of them), an egg cup, a goblet, a kerosene lamp, a covered marmalade jar, a pickle dish, a syrup pitcher and two sizes of water pitchers, plates for serving bread, an oval platter, a powder jar, a salt dish, a sauce dish, a spoon holder (which looks like a tumbler with a foot), a covered sugar bowl, a tumbler, and a wine glass.

Lion glass was usually clear in colour

Collector's Notes

Nineteenth-century pressed-glass pieces, particularly goblets, have been popular with Canadian collectors since the 1950s. Although there is evidence that some patterns were manufactured in Canada, most were imported from the U.S. In addition to books by Ruth Webb Lee, your local public library may have others that help in distinguishing the genuine glass from the reproduction and in identifying patterns. *Early American Pattern Glass* by Alice Hulett Metz (Heritage Antiques, South Orleans, Mass., 2 Volumes, 1975), illustrates 1500 patterns. Other useful books are *Treasury of Canadian Glass* (Clock House, Peterborough, Ontario, c. 1969) and *American and Canadian Goblets* (Clock House, 1971–1974, 2 volumes) by Doris Unitt and Peter Unitt, and two books by Dorothy M. Hammond, *Confusing Collectibles: A Guide to the Identification of Reproductions* (Mid-American Book Co., Leon, Iowa, c. 1969) and *More Confusing Collectibles* (C.B.P. Publishing Co., Wichita, Kansas, 1972). These books deserve to be reprinted with modern-quality illustrations. The publication dates indicate that pressed glass tablewares have been somewhat neglected for at least 20 years. Perhaps it is time once again for collectors to develop an interest in these fine and useful items.

with the lion figures and reliefs in a frosted finish, created by exposing the surface to dilute hydrofluoric acid, one of the few chemicals able to corrode glass. Colours were rare, according to Webb Lee, but the bread plate does turn up in blue, amber, or yellow glass. Some years ago, I saw a kerosene lamp base in pale blue, though she lists it as available only in clear.

From 1830 onwards, the pressed glass made in America was of reasonably good quality since it was made for a middle class or even a wealthy market, and production standards were high. This made it attractive to later generations of collectors. In contrast, pressed glass produced in England was often for the lower end of the market or for the novelty trade.

Since the 1920s, pressed glass has been collected in the United States as part of the Colonial Revival, a nostalgic movement to recreate the cozy interiors, furnishings, and designs of pre-1800 America. By the 1930s, collecting had risen to the point where Ruth Webb Lee's book was needed to classify the patterns and document the dates and origins of each. Lion, she notes, was once one of the easiest patterns to collect. By the time of her writing, however, it had become scarce. By the late 1930s lion glass was being reproduced—copied or revived by competing glass houses.

In her 1950 volume, *Antique Fakes and Reproductions* (revised and enlarged edition, Northborough, Mass.), Webb Lee compares genuine and reproduction lion glass. You'll find that the lower section of your dish, without its cover, is illustrated among the older pieces on page 130, plate 72. Webb Lee describes the relief design in the older, genuine pieces, as being "as clearly defined as the details in a finely carved cameo," noting that "the lion stands out in higher relief, particularly in the hip." This feature is clearly visible in your photograph. The finish she describes as "grayish-white" or "satin," I would describe as very fine and thin, almost like a semi-gloss paint, reminiscent of the sheen of light on satin. The reproductions, on the other hand, have harsh, opaque, chalky white acid frosting.

The details of the relief and figural decoration are not as sharp on the reproductions as on the originals from the late 1800s, possibly because moulds were second generation, or perhaps even worn-out original moulds were used. Some reproduc-

tions were made from glass with a dirty yellow tint. Among the reproductions that Webb Lee documented were celery vases, medium-sized oval compotes, covered sugar bowls, spoon holders, creamers, butter dishes, large round bread plates, egg cups, and goblets on which one of the three lion heads on the stem has a particularly mean scowl, resulting from sagging lips.

These reproductions still scare dealers and collectors today, even though Webb Lee and Alice Hulett Metz (see "Collector's Notes," page 50) published information long ago on how to detect them. I remember hearing of a dealer at an antique show who bought an old collection of lion glass and was not able to sell a single piece because no one would believe they were genuine.

Early lion glass could have been imported into Canada before the federal government imposed protective tariffs in 1878. Once there was much more early American pressed glass in Canada than we see today. Over the years, Americans have bought it up. An older ROM Member once showed me a collection of American pressed glass that her father had assembled in Toronto during the 1930s and '40s. He never paid much more than 25 cents for a piece. At the time, their purchases were much admired by a wealthy visitor from the U.S., a glass collector herself. She couldn't believe what they were able to find.

Today, most pieces of antique pressed glass are worth less than the deductible on a standard home insurance policy. I suggest you take good care of your lion glass dish and enjoy it as an heirloom—and think sometimes about what candies and home-made sweets it might have held in bygone years.

Peter Kaellgren is curator in the ROM's Department of Western Art and Culture, specializing in British and European decorative arts from 1500 onwards.

WE'D LIKE TO HEAR FROM YOU

If you own furniture, silver, glass, metalwork, ceramics, textiles, or small decorative objects that may have an interesting past and have aroused your curiosity, this column is for you. Send a clear colour photograph (or 35-mm colour slide) of the object against a simple background, providing dimensions, a description, any markings, or any known details of its history to: ROM Answers, c/o *Rotunda* Magazine, Royal Ontario Museum, 100 Queen's Park, Toronto, Ontario M5S 2C6. Be sure to enclose a stamped, self-addressed envelope large enough to include any photos that must be returned to you.

Neither *Rotunda* nor the author nor any other person who may be consulted assumes any legal responsibility for these opinions or their ramifications. No financial appraisals will be offered.

Letters will be acknowledged as staff time permits.

Changing of the Guards

Early last century, stiffly uniformed staff watched over the ROM's treasures

ROM ARCHIVES

JULIA MATTHEWS

Six guards, who often had other jobs such as window glazer or door attendant, stand proud in their Museum uniforms. The year is 1914, and some guards have war medals pinned to their chests. Museum carpenters fill the back row. Miss Mary Hand, in the front, was a cataloguer in the Royal Ontario Museum of Archaeology.

Nowadays the dress of Museum guards is more casual. They are considered front-line visitor staff well informed about the Museum's collections in addition to their traditional duties of securing the galleries.

Julia Matthews has been head of the ROM's Library and Archives since 1983.

If you remember an occasion at the ROM or an exhibition that has stayed with you across the years, send us your reminiscences at info@rom.on.ca.

YOU'VE JUST LOST YOUR ENGAGEMENT RING

Will your insurance company pay you enough to replace it?

Chubb Insurance pays you the insured amount of your lost or stolen jewellery – in cash – no deductible, no requirement to replace. Or we'll help you recreate it*.
Ask your broker about your policy.
Then ask about Chubb Insurance.
Contact us at 1-800-465-6391 or at personallines@chubb.com

CHUBB™ INSURANCE

www.chubbinsurance.com

*Coverage refers to itemized jewellery coverage on a Valuable Articles policy.
For promotional purposes, Chubb refers to Chubb Insurance Company of Canada.
This ad is descriptive only. For complete coverage details, please refer to the policy contract.

Want to try and catch me?

Be my guest.

Because by the time you get to where I am,

I'm already somewhere else.

It's an agility afforded by

a powerful Twin Cam 3.5L 215 hp V6 engine

and the Precision Control System,

a choreographed computer-controlled braking system

that keeps me precisely where I want to be:

somewhere just ahead of right now.

Then, like a silver shadow

rounding a corner,

I disappear

without flourish or fanfare.

Pleased to have almost made your acquaintance.

INTRIGUE BY OLDSMOBILE

START SOMETHING

Find out more at gmcanada.com or 1-800-GM-DRIVE.